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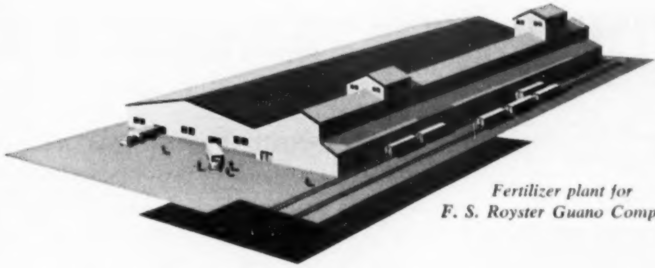

Fertilizer plant for F. S. Royster Guano Company

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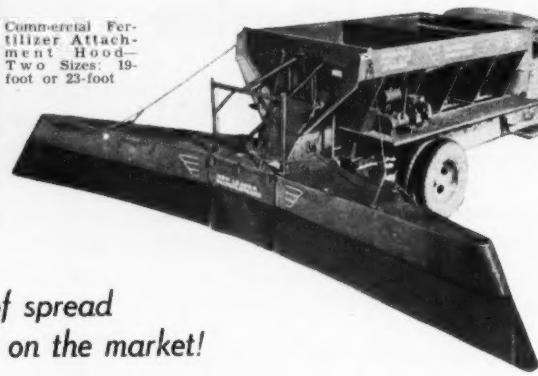

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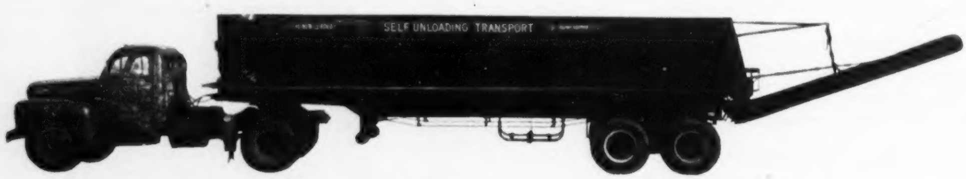

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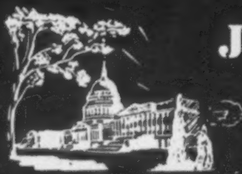
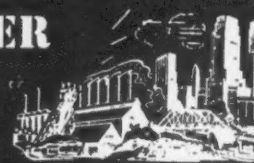


JUST AROUND THE CORNER



By Vernon Mount

Washington is not the madhouse it seems. The trouble is, getting people to do jobs and do them right is a thing that takes time. For example, many thousands of applications for war production are flooding the desks of the various procurement people. They must all be processed, and put on punch-cards. And it takes skill, intelligence, experience to do this. So nothing seems to happen.

But there are sane people back of the mobilization program. There are plans that make good sense, and men who know how to apply them. But these are mostly at the top levels, and they can't personally read all the mail, see all the people, answer all the phone calls that flood in.

On the diplomatic front, things are not so bright. We may at any moment find ourselves in an actual war with China. We may find ourselves pushed off Korea, for all the brave words and for all we may call it a "withdrawal".

Russia wants us embroiled. If she can keep us tangled with various small to medium wars around the rim, and can force us to devote all our time, energy and money to building up a great military establishment,--her plans are working on schedule. What Russia really seems to want is to get us so far in the red that when things crack and "peace breaks out" we'll have such destitution and unemployment that everybody--they think--will flock to the Red banner.

They won't. But meanwhile we are having and will have our troubles. And we'll spend more than 80¢ of each dollar of your taxes for a military establishment.

Yours faithfully,

Vernon Mount

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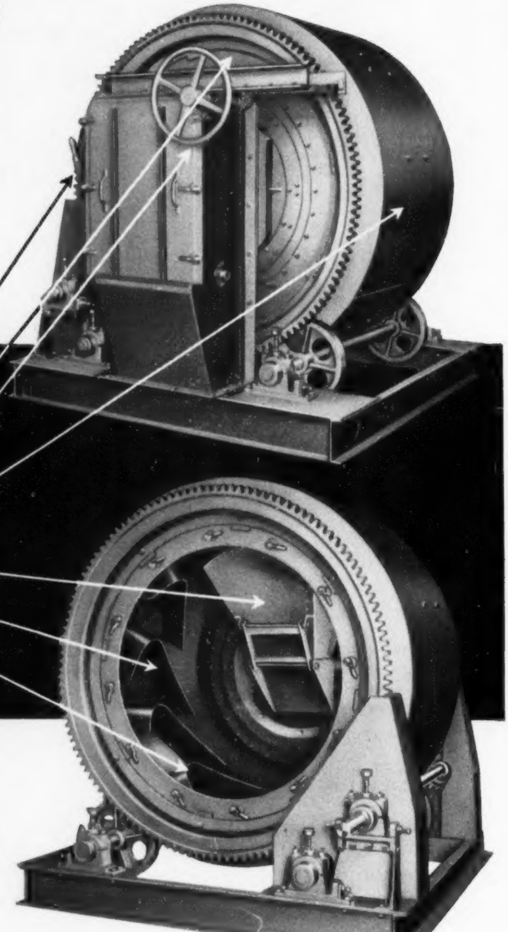

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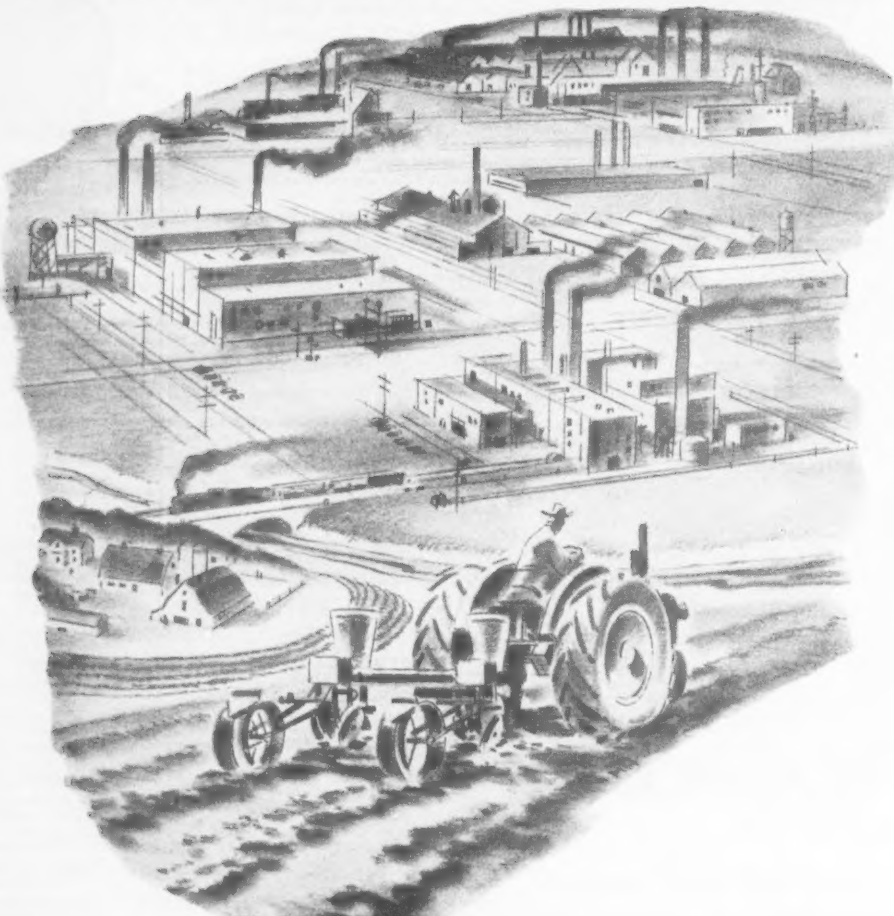
IMPORTANT NEWS



DUVAL POTASH

Renovation Boosts Pasture Yields 35 Percent at Beltsville

Renovation of old permanent dairy pastures at the Agricultural Research Center, Beltsville, Md., in 1945 resulted in an average yearly increase of 35 percent in feed nutrients during the next five years, according to the U. S. Department of Agriculture.

"In other words," says J. B. Shepherd, dairy husbandman for the Bureau of Dairy Industry, "for the past five years our renovated pastures have had a potential milk-producing capacity of 35 percent more than the unrenovated pastures with which they were compared in these experiments."

The renovated pastures not only provided more grazing than the unrenovated pastures, but they furnished more grazing earlier in the spring and later in the fall. Furthermore, from July 15 on, when permanent pastures are often short, the renovated pastures outyielded the unrenovated pastures by an average of 45 percent each year for the five years.

Plant population counts were made each fall by agronomists of the Bureau of Plant Industry, Soils, and Agricultural Engineering, who cooperated in the renovation experiments. They found a progressive decrease in legume content and an increase in grass and weed content, so that in this respect the renovated pastures are now similar to the unrenovated pastures.

According to the agronomists, this shift from legumes to grasses lowers the protein content of the pasture herbage, and for this reason they conclude that renovation at Beltsville should be repeated soon after the fourth year. This would prevent unfavorable changes in the botanical composition of the pasture and a dropping off in total yield.

To start the renovation experiments, several permanent, better-than-average pastures on tillable land were treated with manure and lime and then torn up with a heavy weighted disk harrow in the fall. The cut-up sod was left on the surface as a protection against erosion. Early the following spring 500 pounds per acre of an 0-14-14 fertilizer was broadcast, and the pastures were double disked, then harrowed again before being re-

(Continued on page 61)

It Seems to Me

by BRUCE MORAN

Like all other publications, we subscribe to clipping services that keep us posted on what newspapers all over the nation are saying about this Industry. And every once in a while it becomes painfully evident that there is a need for better coordination in what the Government calls "Information."

For example, in one handful of clips that lie before me, I find items like this:

ITEM: A State agriculture department advising farmers to buy now because defense demands will cut into ingredients.

ITEM: An assistant county agent fearing a short supply of nitrate.

ITEM: The F.A.O. of the United Nations, quoted by the famed Science Services, saying that for the first time since World War II enough fertilizer is being produced to satisfy world demand.

There's a moral in that, but I don't know the answer to it. It seems to me USDA might well call a newspaper conference, or bring up the subject at meetings of agronomists, county agents and the like. And certainly the various agricultural colleges could be helpful in giving the papers the facts straight, so contradictions like that need not occur.

PROCESSES AND FACILITIES FOR MANUFACTURE OF PHOSPHATE FERTILIZERS IN THE UNITED STATES

By K. D. Jacob

Bureau of Plant Industry, Soils, and Agricultural Engineering
Agricultural Research Administration
United States Department of Agriculture
Beltsville, Maryland

The use of commercial fertilizers is a vital factor in the agricultural economy of the United States. Thus, it is estimated that some 15 per cent of our total agricultural production in 1938 was attributed to the use of such fertilizers. The proportion today is estimated to be at least 20 per cent, perhaps as high as 25 per cent, and it is still increasing.

The importance of phosphate in the fertilizer picture is indicated by the fact that in the year ended June 30, 1949 the United States and Territories consumed 1,941,709 short tons of available phosphoric oxide (P_2O_5), as compared with 919,946 tons of nitrogen and 1,073,073 tons of potash—the other two major plant nutrients (35)[1]. Relative to the consumption in 1938, this was an increase of 161 per cent in phosphoric oxide, 140 per cent in nitrogen, and 173 per cent in potash.

Practically from the beginning of the domestic commercial fertilizer industry, 100 years ago, the United States has been virtually self-sufficient in supplies of phosphate fertilizers. Our sustained independence in this field was assured by the discovery and development of the phosphate deposits of South Carolina and subsequently those of Florida, Tennessee, and the West. Having at hand large resources of high-quality, low-cost materials, not only of phosphate rock but also of sulfur ores and other requisites for converting the phosphate into readily available forms, domestic facilities for chemically processing phosphate rock have undergone continual expansion that has kept the output in close pace with the growth, formerly steady but in recent years rapidly accelerated, of the country's demand for phosphate fertilizers.

The high degree of dependence of American agriculture on commercial fertilizers, together with the unsettled conditions in world politics, emphasizes the need for continued careful appraisal of our ability to provide the fertilizer that might be required in the event of the development of an emergency necessitating all-out production of food, fiber, and other agricultural commodities. It is appropriate, therefore, to review at this time our position with respect to processes and facilities for manufacturing phosphate fertilizers, all the more so because of the current shortage of sulfur and sulfuric acid—materials of primary importance to the domestic fertilizer industry as it is presently constituted.

Consumption of Phosphate Fertilizers

Beginning with 1940 a new record for total consumption of available P_2O_5 as fertilizer in the United States and Territories has been established annually. The same has been true of potash and, with one exception, of nitrogen.

As shown in Table I the total consumption of P_2O_5 in the year ended June 30, 1949 was 112.8 per cent higher than that in the calendar year 1940. Regionally the increases ranged from 28.4 per cent in the Territories to 629.1 per cent in the West North Central States. The total increase in the New England, Middle Atlantic, South Atlantic, and East South Central regions—the older areas of fertilizer use—was 62.9 per cent as compared with 216.6 per cent in the East North Central region and 317.6 per cent in the States west of the Mississippi River. The last two areas used 43.1 per cent of the total consumption in 1948-49 but only 25.4 per cent in 1940. The corresponding consumptions in the other States were 55.8 per cent and 72.8 per cent of the respective totals. The distribution of the 1948-49 consumption among the various States is shown in Figure 2.

The available P_2O_5 consumed as fertilizer in recent years has been supplied by a number of materials, including ordinary superphosphate,[2] triple superphosphate[3], wet-mixed base,[4] ammonium phosphates, basic slag, calcium metaphosphate, defluorinated phosphate rock, phosphate rock-magnesium silicate glass, liquid phosphoric acid, raw phosphate rock, and bonemeal and other natural organics. Ordinary superphosphate furnished 80 per cent or more of the P_2O_5 in most years of the period 1900 to 1949 (Figure 1). For the last 20 years triple superphosphate has placed a rather poor second, and in 1949 11.2 per cent of the P_2O_5 consumption was in this form.

Production of Superphosphates

A new record for production of ordinary superphosphate and wet-mixed base in the United States was set in each year of the period 1942 to 1948, reaching a maximum of 1,688,615 short tons of available P_2O_5 or 1.8 times the output in

1. Bold face numerals in parentheses refer to "Literature Cited" at end of paper.

2. The term "ordinary superphosphate" refers to the product, usually containing about 18 to 21 per cent of available P_2O_5, made by treating phosphate rock with sulfuric acid. The term is synonymous with the terms "normal superphosphate" and "regular superphosphate."

3. The term "triple superphosphate" refers to the product, usually containing about 43 to 48 per cent of available P_2O_5, made by treating phosphate rock with phosphoric acid. The term is synonymous with the terms "treble superphosphate" and "double superphosphate."

4. The term "wet-mixed base" refers to the product made by treating a mixture of phosphate rock and nitrogenous organic material (wool waste, fur trimmings, leather scrap, etc.) with sulfuric acid.

1942 (Table II). In recent years the production of wet-mixed base, which is manufactured with the same equipment used in making ordinary superphosphate, has been small—only 10,921 tons of available P_2O_5 in 1949.

In the case of triple superphosphate new production records were established in each of the years 1936 to 1940, with the output steadily increasing from 58,400 to 151,400 short tons of available P_2O_5 (Table II). Subsequently, the production decreased somewhat for several years, chiefly because of the diversion to military use of considerable elemental phosphorus which otherwise would have been made into triple superphosphate. The downward trend in production was reversed in 1946 and new output records have been set in each of the succeeding years, with an all-time high of 320,000 tons of available P_2O_5 estimated for 1950. Although production of ordinary superphosphate has levelled off since 1947, production of triple superphosphate is still increasing, as indicated by the fact that the output in September 1950 was at an annual rate of 342,000 tons of available P_2O_5.

Since 1939 superphosphate production in terms of available P_2O_5 has increased to new records each year except one (1949), and the output in 1950 is estimated at 1,903,000 tons. (Table II).

Facilities for Manufacture of Phosphate Fertilizers

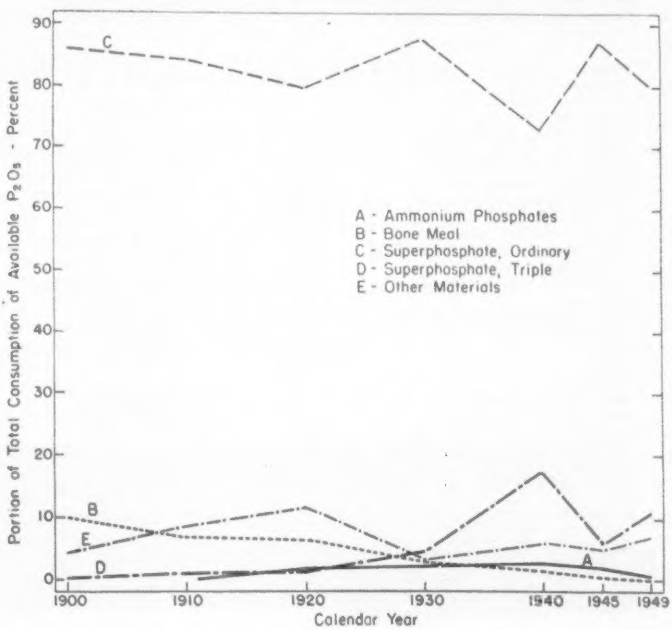
Facilities in the United States for producing chemically processed phosphates include plants for manufacture of fertilizers—ordinary and triple superphosphates, ammonium phosphates, liquid phosphoric acid, calcium metaphosphate, defluorinated phosphate rock, phosphate rock-magnesium silicate glass, and basic slag—as well as plants for making phosphate chemicals for industrial and technical uses. Small quantities of byproduct, spent, and waste materials from the latter plants are used as phosphate fertilizers. The distribution among the various States of the primary facilities for making chemically processed phosphates, as of July 15, 1950, is indicated in Figure 2, which also shows the approximate locations of the principal deposits of phosphate rock and the consumption of available P_2O_5 as fertilizer by States in the year ended June 30, 1949.

Ordinary Superphosphate

As shown in Table III, the 140 plants that produced ordinary superphosphate and wet-mixed base in 1940 had a total annual capacity of 1,511,888 short tons of available P_2O_5. By 1950 the number of plants had increased by 33 per cent to 200 (distributed among 32 States) and the total capacity by 70 per cent to 2,580,147 tons. At least one additional plant is under construction and others are projected for the near future.

As might be expected the distribution of the plants among the various regions (Table IV) is approximately in the same order as the consumption of available P_2O_5 therein (Table I). In 1950 the South Atlantic region, as for many years previously, had the most plants, followed in order by the East North Central and the East South Central regions. In point of plants established since 1940 the East North Central region leads with 17. The South Atlantic region comes next with 13 new plants, and the West North Central region, which had no superphosphate facilities in 1940, is third with 11 such plants. The other 14 new plants are distributed among the New England, Mountain, Pacific, and East and West South Central regions, chiefly the last two. The Middle Atlantic region was the only area showing a decrease in the number of ordinary superphosphate plants during the period 1940 to 1950. The order of the regions as regards the number of new plants established in this period (Table IV) is approximately the same as their order with respect to the increase in consumption of available P_2O_5 (Table I).

Figure 1. Distribution of Consumption of Phosphoric Oxide as Fertilizer Among the Various Materials.



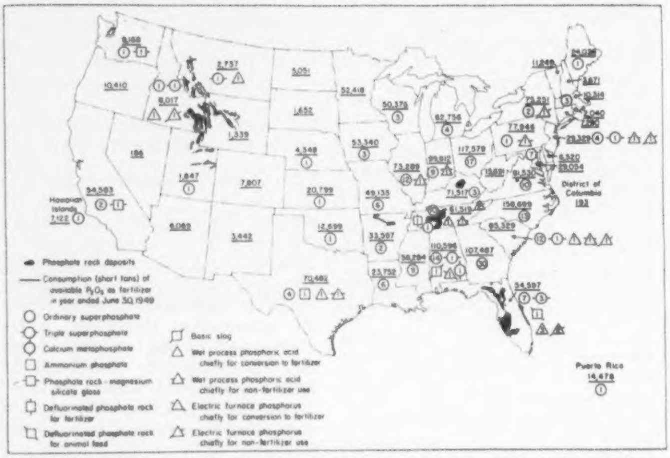


Figure 2. Distribution of Phosphate-Rock Deposits and Processing Facilities and Consumption of Phosphate Fertilizer in the United States.

The 200 ordinary superphosphate plants existing in 1950 were operated by 81 companies (Table V). They included 15 plants operated by 13 farmer cooperatives, as compared with only one such plant in 1940. Among the 81 companies 58 operated only one plant, whereas four companies operated a total of 78 plants—15 to 27 each.

Since economical manufacture of superphosphate depends on convenient supplies of low-cost sulfuric acid many ordinary superphosphate plants have coexisting facilities for making this acid. Of the 200 ordinary superphosphate plants operating in 1950, 90 plants, or 45 per cent, had such facilities (Table VI). In the South Atlantic region 65 per cent of the 72 superphosphate plants also had acid-making facilities, while all of the 11 plants in the West North Central region were dependent on outside sources for acid.

The coexisting acid facilities comprised contact, Mills-Packard, and mostly box-chamber units. Among the 90 superphosphate plants that had acid facilities, 83 made acid by only one process—contact 17, Mills-Packard 12, chamber 54. The others operated both contact and chamber units (2 plants), contact and Mills-Packard units (1 plant), or chamber and Mills-Packard units (4 plants).

Until recent years, practically all superphosphate plants had coexisting facilities for grinding phosphate rock. Now, however, large tonnages of phosphate are ground at the mines and many superphosphate manufacturers purchase ready-ground rock. Among the 200 plants operating in 1950, 65 had no rock-grinding facilities (Table VI).

Thirty years ago very few ordinary superphosphate plants in the United States were equipped with mechanical den systems and all of these were non-continuous types. In 1950, however, more than half the plants had such systems, including 16 plants with so-called continuous dens (Table VII). The non-continuous systems in current use comprise the Forbis, Svenska, and chiefly the Sturtevant types **(28)**, while the Sackett **(8)** and especially the Broadfield **(29)** types are the principal continuous systems in domestic operation. In the plants that do not have mechanical den systems the superphosphate is removed from the dens by various means, including draglines, overhead cranes, power shovels, and even manual labor.

Triple Superphosphate

According to Mehring **(23)**, triple superphosphate was first manufactured in the United States in 1890 by the American Phosphate and Chemical Company, Baltimore, Md., using phosphoric acid made by the sulfuric acid process. It was not until 1907, however, that the domestic industry was placed on a permanent basis. In that year the Virginia-Carolina Chemical Corporation commenced the manufacture of triple superphosphate in a wet-process plant at Charleston, S. C., which is still in operation.

Triple superphosphate was first made on a large scale with electric-furnace acid in 1914 to 1916 by the Piedmont Electro-Chemical Company, Mount Holly, N. C., and small quantities were produced with such acid in 1924 and 1925 by the Federal Phosphorus Company, Anniston, Ala. Beginning in 1931 triple superphosphate has been produced continuously with furnace-procsss acid, first by the Victor Chemical Works, Nashville, Tenn., using blast-furnace acid, and subsequently with electric-furnace acid by other companies and by the Tennessee Valley Authority at Wilson Dam, Ala.

The total annual capacity for manufacture of triple superphosphate in the United States increased from 44,000 short tons of available P_2O_5 in five plants in 1930 to 180,000 tons in eight plants in 1940 and to 315,616 tons in nine plants in 1950 (Table VIII). Important enlargements of several existing plants are being made, and construction of new plants is understood to be projected for the near future.

Among the nine plants producing triple superphosphate in 1950, seven made phosphoric acid by the sulfuric acid process—of which five produced sulfuric acid in coexisting facilities—and one (Tennessee Valley Authority) by the electric-furnace process. The other used furnace-process spent acid from an industrial operation. Three of the plants are located in Florida and one each in Alabama, Idaho, Montana, New Jersey, South Carolina, and Tennessee. Two of the Florida plants commenced operation in 1949 and the Idaho plant in 1950. Another plant in Tennessee, which manufactured triple superphosphate fertilizer for some 20 years, now converts its entire output into a defluorinated product for use as a phosphorus supplement in animal feeds.

TABLE I—Regional Consumption of Available P_2O_5(a) as Commercial Fertilizer in the United States, 1940 and 1948-49

Region	1940(b)	1948-49(c)	Increase		Portion of Total Consumption 1940	1948-49
	Short Tons	Short Tons	Short Tons	Per Cent	Per Cent	Per Cent
New England(d)	41,949	58,602	16,653	39.7	4.6	3.0
Middle Atlantic(e)	160,589	233,984	73,395	45.7	17.6	12.1
South Atlantic(f)	287,553	487,642	200,089	69.6	31.5	25.1
East North Central(g)	127,555	403,812	276,256	216.6	14.0	20.8
West North Central(h)	25,612	186,743	161,131	629.1	2.8	9.6
East South Central(i)	174,204	301,916	127,712	73.3	19.1	15.6
West South Central(j)	36,372	140,530	104,158	286.4	4.0	7.2
Mountain(k)	10,751	33,444	22,693	211.1	1.2	1.7
Pacific(l)	31,411	74,161	42,750	136.1	3.4	3.8
Territories(m)	16,258	20,875(n)	4,617	28.4	1.8	1.1
United States	912,255	1,941,709	1,029,454	112.8	100.0	100.0

(a) Total P_2O_5 minus P_2O_5 insoluble in neutral ammonium citrate solution.
(b) Calendar year. Data from Mehring et al (24).
(c) Year ended June 30, 1949. Data from Scholl and Wallace (35).
(d) Maine, N. H., Vt., Mass., R. I., Conn.
(e) N. Y., N. J., Pa., Del., D. C., Md., W. Va.
(f) Va., N. C., S. C., Ga., Fla.
(g) Ohio, Ind., Ill., Mich., Wis.
(h) Minn., Iowa, Mo., N. Dak., S. Dak., Nebr., Kans.
(i) Ky., Tenn., Ala., Miss.
(j) Ark., La., Okla., Tex.
(k) Mont., Idaho, Wyo., Colo., N. Mex., Ariz., Utah, Nev.
(l) Wash., Oreg., Calif.
(m) Hawaii, Puerto Rico.
(n) Includes 12 tons consumed in Alaska.

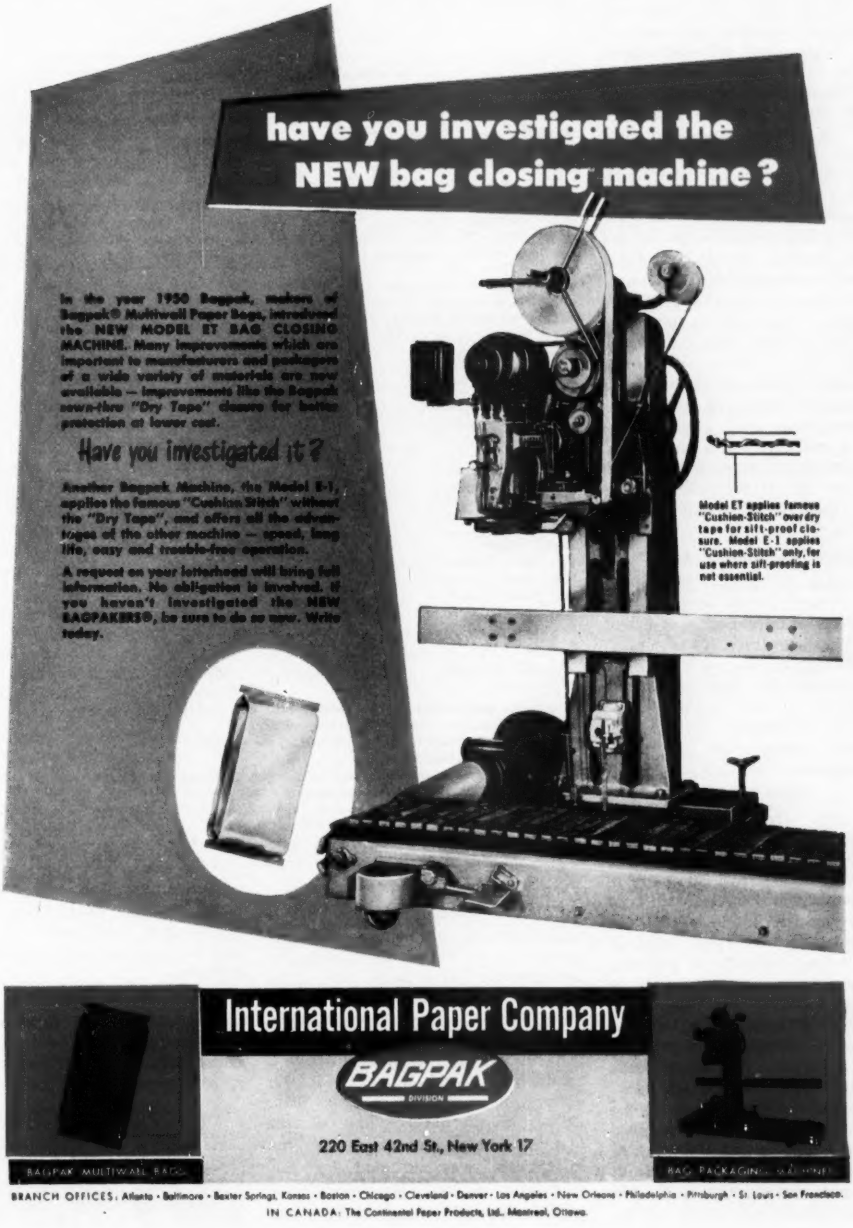
TABLE II—Production of Superphosphates in the Continental United States

Calendar Year	Short Tons of Available P_2O_5(a): Ordinary Superphosphate(b)	Triple Superphosphate	Total
1930	751,200	43,300	794,500
1935	490,200	41,000	531,200
1940	724,400	151,400	875,800
1941	808,900	146,300	955,200
1942	926,000	144,600	1,070,600
1943	1,140,879	132,292	1,273,171
1944	1,213,059	126,484	1,339,543
1945	1,334,001	112,932	1,446,933
1946	1,421,197	145,044	1,566,241
1947	1,683,923	172,725	1,856,648
1948	1,688,615	210,920	1,899,535
1949	1,644,584	246,827	1,891,411
1950(c)	1,583,000	320,000	1,903,000

(a) The data for 1930 to 1942 are from Parker et al (27, p. 90). Those for 1943 to 1949 are from U. S. Department of Commerce, Bureau of the Census, Facts for Industry, Series M19D-09, Superphosphate—Summary for 1949, Apr. 18, 1950.
(b) Includes small quantities of wet-mixed base.
(c) Estimated on basis of production in January-September as reported by the Bureau of the Census.

Ammonium Phosphates

Beginning in 1917 fertilizer-grade ammonium phosphates were made by the American Cyanamid Company at Warners, New Jersey, until about 1941. Subsequently, there was no domestic manufacture of such material until 1946, when the triple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superphosphate plant at Pasadena, Texas, built with Government funds during World War II and later sold to a private company, was converted to production of ammonium phosphate fertilizer—chiefly the 16-20-0 ammonium phosphate—ammonium sulfate product—with wet-process phosphoric acid. With the exception of a very small quantity made with purchased phosphoric acid, this plant—now operated by the Mathieson Chemical Corporation—presently accounts for all the domestic output of fertilizer-grade ammonium phosphates.

The 11-48-0 and 16-20-0 grades of ammonium phosphate have been manufactured since 1930 on a large scale at Trail, British Columbia, with locally produced sulfuric acid and synthetic ammonia and Montana phosphate rock **(3)**. A considerable portion of the output has been imported into the United States for use as fertilizer, chiefly in the Pacific Coast and Rocky Mountain States.

Liquid Phosphoric Acid

Production of liquid phosphoric acid for direct use as fertilizer—by application in irrigation water and by injection into the soil—is confined to two plants, one each in Idaho and Montana. In both cases the acid—made by the sulfuric acid process—is produced in conjunction with manufacture of triple superphosphate.

Basic Slag

The only domestic supply of basic slag is the low-analysis material produced by the Tennessee Coal, Iron and Railroad Company in the Birmingham, Ala., district where it was first made in 1915 **(4)**. It is used only for direct application to the soil, chiefly to pastures and forage crops and primarily as a liming material and source of phosphorus. The domestic slag is guaranteed to contain eight per cent of total P_2O_5, but it often exceeds this figure by a considerable margin. Some 60 to 90 per cent of the P_2O_5 is soluble in neutral ammonium citrate solution, and the marketed product has a fineness of about 70 to 90 per cent through a No. 100 U. S. standard sieve.

TABLE III

Annual Capacity of Plants Manufacturing Ordinary Superphosphate and (or) Wet-Mixed Base in the Continental United States, Calendar Years 1940, 1945, 1947, and 1950(a)

Year	Number of Plants	Short Tons	
		Material(b)	Available P_2O_5
1940(c)	145	8,399,378	1,511,888
1945(d)	159	11,486,625	2,067,503
1947(e)	176	13,246,847	2,384,433
1950(f)	200	14,334,147	2,580,147

(a) The data relate only to plants that operated or were expected to operate in the years indicated.

(b) Basis 18 per cent available P_2O_5. The assumptions on which the estimates are based are not uniform throughout; those for the years 1940, 1945, and 1947 are summarized by Jacob (17).

(c) Data from Jacob (16).

(d) Data from W. R. Corey, U. S. War Production Board, Chemicals Bureau, Inorganics Branch, WPBI-3191, July 18, 1945.

(e) Data from Jacob (17).

(f) As of July 15.

TABLE IV

Regional Distribution of Plants Manufacturing Ordinary Superphosphate and (or) Wet-Mixed Base in the Continental United States, Calendar Years 1940, 1945, 1947, and 1950(a)

Region(b)	1940(c)	1945(d)	1947(e)	1950(f)
New England	3	4	4	4
Middle Atlantic	15	14	14	14
South Atlantic	59	68	71	72
East North Central	28	30	36	45
West North Central	0	2	6	11
East South Central	30	29	32	36
West South Central	8	9	10	13
Mountain	0	1	1	2
Pacific	2	2	2	3
United States(g)	145	159	176	200

(a) The data relate only to plants that operated or were expected to operate in the years indicated.

(b) See Table I for the States comprising the regions.

(c) Data from Jacob (16).

(d) Data from U. S. Department of Commerce, Bureau of the Census, Facts for Industry, Series M19D-26, Superphosphate—February 1946, Apr. 10, 1946.

(e) Data from Jacob (17).

(f) As of July 15.

(g) In addition, there was 1 plant in Hawaii and 1 in Puerto Rico in each of the years.

Calcium Metaphosphate

Calcium metaphosphate **(7)** is made only by the Tennessee Valley Authority at Wilson Dam, Ala. Its manufacture on a large pilot-plant scale was started in the year ended June 30, 1938. A new unit to demonstrate recently developed improvements in the process on a production basis superseded the older unit in the last half of 1949. Domestic marketing of calcium metaphosphate, through farmer cooperatives, was initiated by the Authority in 1950. Previously, except for several thousand tons exported under the lend-lease program during World War II, the output was distributed for experimental testing and demonstration purposes.

Defluorinated Phosphate Rock

Large pilot-scale production for fertilizer use of fused tricalcium phosphate, a type of defluorinated phosphate rock,[5] was started by the

5. The term "defluorinated phosphate rock" refers to the products obtained by heating natural phosphates, usually phosphate rock, at high temperatures in the presence of silica and water vapor for the purpose of volatilizing the fluorine and converting the P_2O_5 into plant-available forms, chiefly **alpha** tricalcium phosphate. The term "alpha phosphate" is also applied to this class of products.

Tennessee Valley Authority in May 1945 in oil-fired, shaft-type furnaces near Columbia, Tenn. **(13)**. The product has been used solely for experimental testing and demonstration purposes. Although this is believed to be the only such plant in the world, a sintered product—presently sold entirely for use as a phosphorus supplement in animal feeds—has been made on a large scale in oil-fired rotary kilns by the Coronet Phosphate Company since June 1944, first at West Conshohocken, Pa., and now at Plant City, Fla. **(38)**. Like the TVA plant, this is also believed to be the only operation of its kind in the world.

Phosphate Rock-Magnesium Silicate Glass

Phosphate rock-magnesium silicate glass[6] **(15, 26, 36)** was first produced on a large scale by The Permanente Metals Corporation (now the Kaiser Aluminum & Chemical Corporation, Chemical Division) at Permanente, Calif., in 1943 by fusing phosphate rock with serpentine. This facility is being maintained in operating condition. Commercial production of the material, using olivine instead of serpentine, was started in early 1948 by Manganese Products, Inc., at Seattle, Wash. These products contain about 20 per cent of total P_2O_5, some 90 per cent of which is citrate-soluble provided the material is a glass and is finely ground.

Wet-Process Phosphoric Acid For Non-fertilizer Use

Among the 15 facilities for producing phosphoric acid by the sulfuric acid process are seven plants—one each in Illinois, Indiana, New Jersey, Pennsylvania, South Carolina, Tennessee, and Texas—which make the acid chiefly, if not entirely, for non-fertilizer purposes. At most of the seven plants much of the phosphoric acid is converted into sodium phosphates, in the manufacture of which considerable quantities of byproduct material consisting chiefly of precipated phosphates of calcium, iron, and aluminum are obtained. This material commonly contains upwards of 30 per cent of available P_2O_5 and is an excellent conditioning agent in mixed fertilizers, for which purpose it is used at the rate of about 50 pounds per ton.

6. The term "phosphate rock-magnesium silicate glass" refers to the products obtained by fusing proportioned mixtures of phosphate rock and serpentine or olivine at approximately 1500°C. in electric furnaces and quenching the melt in a violent spray of water. These products are also called "calcium-magnesium phosphate," "Thermo-Phos," and "MP Phosphate."

TABLE V

Ordinary Superphosphate Plants Operated by Individual Companies in the Continental United States, as of July 15, 1950

Number of Companies(a)	Number of Plants: Operated by Each Company	Number of Plants: Total
4	15-27(b)	78
2	10-11	21
2	4-5	9
4	3	12
11	2	22
58	1	58
81(c)	1-27	200

(a) Companies operating under different names but having the same officials are included as one company, as are companies known to be subsidiaries of, or controlled wholly or in part by, another company; includes wet-mixed base.

(b) 15, 17, 19, and 27 plants, respectively.

(c) Includes 13 farmer cooperatives that operate 15 plants—3 in Mo., 2 each in Ga. and Ind., and 1 each in Md., Ohio, Ill., Mich., Wis., Ky., Miss., and Tex.

TABLE VI

Sulfuric Acid and Rock Grinding Facilities at Ordinary Superphosphate Plants in the Continental United States, as of July 15, 1950

Region	Total Superphosphate Plants	Plants Having Coexisting Facilities for— Making Sulfuric Acid: Total	Contact	Box Chamber	Mills-Packard	Grinding Rock
New England	4	2	1	1	0	4
Middle Atlantic	14	8	2(a)	6(b)	0	13
South Atlantic	72	47	6(c)	34(d)	7(e)	58
East North Central	45	15(f)	6(f)	7	2	29
West North Central	11	0	0	0	0	2
East South Central	36	10	1	7	2	22
West South Central	13	6	2	3(g)	1(h)	6
Mountain and Pacific	5	2	2	0	0	1
United States	200	90(f)	20(f)	58(i)	12(j)	135(k)

(a) Both plants also have box-chamber facilities.

(b) Does not include the 2 plants that also have contact facilities.

(c) Includes 1 plant that also has Mills-Packard facilities.

(d) Includes 3 plants that also have Mills-Packard facilities.

(e) Does not include the plant that also has contact facilities nor the 3 that also have box-chamber facilities.

(f) Does not include 3 plants that have a jointly owned contact plant which is not coexisting with either of the 3 superphosphate facilities.

(g) Includes 1 plant that also has Mills-Packard facilities.

(h) Does not include the plant that also has box-chamber facilities.

(i) Does not include 2 plants that also have contact acid facilities.

(j) Does not include 1 plant that also has contact facilities nor 4 that also have box-chamber facilities.

(k) Includes 5 plants (3 in the East South Central and 1 each in the South Atlantic and West South Central regions) that have grinding facilities but currently purchase ready-ground rock.

Electric-Furnace Phosphorus

Current facilities for manufacture of elemental phosphorus by the electric-furnace process in the United States comprise nine plants—two each in Florida and Tennessee and one each in Alabama, Idaho, New Jersey, New York, and South Carolina—of which all but the plant of the Tennessee Valley Authority,

Wilson Dam, Ala., produce phosphorus primarily for non-fertilizer purposes. A tenth plant, also for non-fertilizer phosphorus, is projected for early construction in Montana, and important enlargements of several of the existing plants are now under way. Reduction of phosphate rock by the blast-furnace method in the United States **(9)** was discontinued in 1938 when the only operator, the Victor Chemical Works, Nashville, Tenn., switched to the electric-furnace process. Though some triple superphosphate was produced, the output of this blast-furnace plant was used primarily for non-fertilizer purposes.

As of June 30, 1950 the nine plants in operation at that time had a total estimated capacity of 156,000 short tons of elemental phosphorus per year **(1)**.

Aside from the primary productions of triple superphosphate, calcium metaphosphate, and fused tricalcium phosphate by the Tennessee Valley Authority, the electric-furnace process contributes, either directly or indirectly, several plant-nutrient materials. As previously mentioned there is some production of triple superphosphate with furnace-process spent phosphoric acid from an industrial operation. Various phosphorus compounds, made mostly if not entirely from elemental phosphorus, are used as catalysts in certain gasoline refining processes. Studies of a number of spent catalysts from these processes indicate that they are good sources of P_2O_5 for plant growth **(2, 11)**, and it is understood that they are being used for such purpose to some extent.

A so-called potash-phosphate ash containing about 12 to 16 per cent of K_2O and 20 to 25 per cent of available P_2O_5 is obtained as a by-product of the manufacture of electric-furnace phosphorus. Some use of this material as a fertilizer is being made.

Calcium silicate slag from manufacture of electric-furnace phosphorus is a useful soil-liming material **(21)**. It also contains some 1 to 2 per cent of P_2O_5 which appears to have definite fertilizer value. Considerable quantities of the slag, mostly from the Alabama and Tennessee plants, have been distributed for agricultural use. The Tennessee Valley Authority alone sold about 108,000 tons of the material in the year ended June 30, 1949.

TABLE VII

Types of Den Systems in Ordinary Superphosphate Plants of the Continental United States, as of July 15, 1950

Region	Total Plants	Plants Equipped with: Mechanical Dens		Non-mechanical Dens: Method of Ex-denning				
		Continuous(a)	Non-continuous(b)	Manual	Drag-line	Overhead Crane	Wever Excavator	Other Methods(c)
New England	4	0	2	1	0	0	1	0
Middle Atlantic	14	1	7	0	2	1	1	2
South Atlantic	72	4(d)	32	4	18	5	3	6
East North Central	45	3	18(e)	2	14	5	2	1
West North Central	11	0	8	0	3	0	0	0
East South Central	36	3	17	3	10	0	2	1
West South Central	13	4	8	0	1	0	0	0
Mountain and Pacific	5	1	3	0	0	0	0	1
United States	200	16(d)	95(e)	10	48	11	9	11

(a) Sackett, special, and Broadfield types, principally the last.
(b) Forbis, Svenska, and Sturtevant types, principally the last.
(c) Power shovels and scoops, hoists, and special excavators.
(d) Includes one plant having both continuous and non-continuous mechanical dens.
(e) Includes one plant having both mechanical and non-mechanical (crane-excavated) dens.

TABLE VIII

Annual Capacity of Plants Manufacturing Triple Superphosphate in the Continental United States, Calendar Years 1930, 1940, 1945, 1947, and 1950(a)

Year	Number of Plants	Short Tons: Material(b)	Short Tons: Available P_2O_5
1930(c)	5	97,800	44,000
1940(c)	8	400,000	180,000
1945(d)	9	496,500	223,400
1947(d)	7	488,900	220,000
1950(e)	9	701,368	315,616

(a) The data relate only to plants that operated or were definitely planned for operation in the years indicated. They represent the total maximum practical operating capacities of the individual plants on an annual basis at any time during the specific year regardless of the duration of operation.
(b) Basis 45 per cent available P_2O_5.
(c) The capacity figures are from Parker et al (27, p. 60).
(d) Data from Jacob (17).
(e) As of July 15.

TABLE IX

Sales (Short Tons) of Phosphate Rock for Direct Application to the Soil in the United States, Calendar Years 1940 and 1945 to 1949, by Sources(a)

Year	Florida	Tennessee	Western States(b)	Total(c)
1940	43,773	74,584	690	119,047
1945	239,187	219,775	2,078	461,040
1946	352,324	237,894	1,251	591,469
1947	543,779	311,674	367	855,820
1948	575,114	303,407	8,325	886,846
1949	584,987	233,888	1,743	820,618

(a) As reported to the U. S. Bureau of Mines by domestic producers.
(b) Idaho, Montana, Utah, and Wyoming.
(c) The total sales in 1939, 1941, 1942, 1943, and 1944 were 107,147, 160,380, 206,341, 217,203, and 287,544 tons, respectively.

Phosphate Rock for Direct Use As Fertilizer

A new record for sales of raw phosphate for direct application to the soil was established in 1939 and in each of the succeeding nine years, with a maximum of 886,846 short tons in 1948—more than eight times

the sales in 1939 (Table IX). Of the sales in 1949 (820,618 tons) 71.3 per cent was supplied by Florida (including soft phosphate, waste-pond phosphate, and mostly land-pebble phosphate), 28.5 per cent by Tennessee (brown-rock phosphate), and 0.2 per cent by the western States. As for many years, the greater portion of the entire output was used in Illinois.

Most, if not all, of the phosphate rock used for direct application to the soil is ground or otherwise prepared at or near the mines. Aside from several companies producing soft and waste-pond phosphates in Florida, such grinding facilities include at least 17 plants—seven in the Florida land-pebble district, five in Tennessee, and five in the West—some of which are not currently grinding rock for direct application. In addition, there are some mining operations which have coexisting facilities for grinding rock for other purposes. Estimates of the capacity of present facilities for producting raw phosphates for direct use as fertilizer are not available.

The total P_2O_5 content of the ground phosphate rock sold for direct application in the United States usually ranges from about 29 to 35 per cent, while that of the soft and waste-pond phosphates is about 20 to 25 per cent. In all cases, only some 5 to 10 per cent of the total P_2O_5 is soluble in neutral ammonium citrate solution **(19)**. The fineness specifications for the ground rock range from 60 to 95 per cent or more through a No. 200 U. S. standard sieve.

Other Sources of P_2O_5

Other domestic sources of P_2O_5 for fertilizer use comprise chiefly a wide variety of natural organic materials, such as bonemeal, oilseed meals, tankages, fish products, dried manures, sewage products, etc. Although data on the capacities for producing these materials have not been compiled, it is estimated that the quantities used annually from domestic sources as fertilizer furnish about 13,000 tons of total P_2O_5.

Among the phosphate fertilizer materials not currently made in the United States are some which have interesting possibilities and are worthy of mention. Several attempts have been made in this country to manufacture fertilizers by heating phosphate rock with alkali salts, but these efforts have not met with sustained success. In Germany, however, a product of this kind, called Rhenania phosphate, has been made on a large scale for some 30 years **(12)**. There has recently been renewed interest in the question of domestic production of this type of material, though no announcement has yet been made of definite plans therefor.

Considerable dicalcium phosphate is made in the United States from electric-furnace phosphoric acid and as a byproduct of the manufacture of gelatin and glue from bones, but this material—being, as it is, of high quality and very low in fluorine—is used mostly, if not entirely, as a phosphorus supplement in animal feeds and for other non-fertilizer purposes. Some years ago limited quantities of fertilizer-grade dicalcium phosphate were made domestically from phosphate rock with the aid of hydrochloric acid. Currently there is much interest in the possibilities of domestic production of the fertilizer-grade material, especially with the aid of nitric acid by means of processes similar to those in large-scale operation in the Netherlands, Norway, and other European countries **(22, 30, 31)**.

Capacity for Production of Phosphate Fertilizers

As of July 15, 1950, the total capacity for production of phosphate fertilizers in the continental United States is estimated a t,3066,823 short tons of available P_2O_5 (equivalent to 17,037,906 tons of 18 per cent superphosphate), distributed as shown in Table X. Of this capacity, 84 per cent is in the form of ordinary superphosphate and wet-mixed base, 10 per cent as triple superphosphate, and 6 per cent as a wide variety of other materials. In addition, there is a small capacity for production of P_2O_5 as ordinary superphosphate and natural organic materials in Hawaii and Puerto Rico.

TABLE X

Annual Capacity for Production of Fertilizer Phosphates in the Continental United States, as of July 15, 1950

Material	Number of Plants	Available P_2O_5(a) Short Tons
Ordinary superphosphate and wet-mixed base	200	2,580,147
Triple superphosphate	9	315,616
Ammonium phosphates(b), liquid phosphoric acid for direct application, and calcium metaphosphate	4(c)	82,010
Basic slag, defluorinated phosphate rock(d), and phosphate rock-magnesium silicate glass	4(e)	41,050
Byproduct and spent materials of inorganic origin(f)	(g)	11,000(h)
Natural organic materials(i)	(g)	13,000(h) (j)
Phosphate rock for direct application(k)	17	24,000(h)
Total	234	3,066,823

(a) Total P_2O_5 minus P_2O_5 insoluble in neutral ammonium citrate solution.
(b) Includes ammonium phosphate—ammonium sulfate products, such as the 16-20-0 material.
(c) Ammonium phosphates 1, phosphoric acid 2, calcium metaphosphate 1.
(d) Fused tricalcium phosphate produced by the Tennessee Valley Authority.
(e) Basic slag 1, defluorinated phosphate rock 1, phosphate rock-magnesium silicate glass 2.
(f) Potash-phosphate ash from electric furnace manufacture of elemental phosphorus; byproduct phosphate from manufacture of wet-process sodium phosphates; spent catalysts from petroleum industry.
(g) Data not available.
(h) Estimated consumpton.
(i) Bonemeal, oilseed meals, tankages, fish products, dried manures, sewage products, etc.
(j) Total P_2O_5.
(k) Ground phosphate rock, soft phosphate, and waste-pond phosphate; averages about 3 per cent of available P_2O_5.

Since the present total capacity for producing available P_2O_5 is 1.6 times the domestic consumption of this plant nutrient in the year ended June 30, 1949, there would seem to be no national need for additional capacity, at least for the time being. There is undoubtedly need, however, for a very substantial increase in the Nation's capacity to produce the more concentrated types of phosphate fertilizers. That this need is well recognized is evidenced by the fact that major additions to our facilities for making triple superphosphate are now in progress and others are understood to be programmed for the near future.

The Problem of Sulfuric Acid In the Phosphate Fertilizer Industry

A matter of vital importance to the domestic phosphate fertilizer industry is the problem posed by the suddenly developed shortage in the supply of elemental sulfur for manufacture of sulfuric acid, an indispensible chemical in the production of ordinary superphosphate and wet-process triple superphosphate and ammonium phosphates—products which account for nearly 95 per cent of our present capacity for making chemically processed phosphate fertilizers. The significance of the problem is further indicated by the fact that the production of these three types of phosphates in 1950 required the use of materials containing the equivalent of about 1,200,000 short tons of sulfur, a very considerable portion of which was in the form of elemental sulfur.

Permanent solution of the problem will involve, among other things, some or all of the following expedients: (1) continued search for and development of additional deposits of native sulfur and sulfur-bearing minerals; (2) more extensive use of pyrites for manufacture of sulfuric acid; (3) increased recovery of sulfur values from natural and industrial gases **(10, 20, 33, 34)**; (4) greater utilization of local sources of spent sulfuric acids; and (5) wider manufacture of phosphate fertilizers by processes that do not require the use of sulfuric acid. For the purpose of this paper it will suffice to discuss briefly only the last two of these expedients.

Production of Superphosphate With Spent Sulfuric Acid

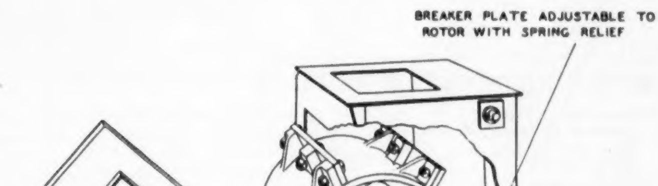
The suitability of a spent sulfuric acid, either alone or in mixture with fresh acid, for manufacture of superphosphate involves considerations such as freedom of the acid from substances that are toxic to plants and from impurities that adversely affect the manufacturing operation or the physical properties of the superphosphate. The behavior of the impurities is of more concern in the production of triple superphosphate than of the ordinary material.

For many years nearly pure, denitrated, spent acids from the manufacture of nitrocellulose and nitroglycerin have been widely used in production of superphosphates and for other purposes. Large quantities of ordinary superphosphate have been made with the aid of the so-called sludge acids formerly available in considerable volume from the petroleum refining industry, and more recently with spent acid from the alkylation process for aviation gasoline. Even with very heavy applications of P_2O_5, these products appear to have no toxic effects on plants or on the nitrifying organisms in the soil **(5, 6, 18, 25, 37)**.

Limited quantities of ordinary superphosphate have been made with the aid of spent sulfuric acid from picric acid manufacture. The picric acid content of the superphosphate should not exceed 0.25 per cent, however, because of its possible toxicity to plants **(32)**. Other spent acids used in the production of ordinary superphosphate include materials from metal treating and refining plants and from manufacture of pigments (especially titanium compounds), dyes, alcohols, and certain chemicals **(16)**.

In greenhouse tests with snap beans and millet, the plant-growth effects of an experimental superphosphate made with spent acid containing 0.33 per cent by weight of sulfonated coal-tar products and anthrancene, chiefly the latter, were about the same as those obtained with comparable applications of fresh-acid superphosphate (maximum of 1,500 pounds of P_2O_5 per acre).[7] Likewise, heavy applications

7. Unpublished data from Division of Fertilizer and Agricultural Lime, Bureau of Plant Industry, Soils, and Agricultural Engineering.



This illustration is from a recent bulletin issued by Sturtevant Mill Co., Harrison Square, Boston 22, Mass. It illustrates their rotary pulverizer for grinding tailings. Full details are available if you will write the company at the address given.

of P_2O_5 (up to 2,000 pounds per acre) in the form of superphosphates made with mixed acids containing 25 to 50 per cent of spent acid from manufacture of chloral had no toxic effects on the growth of snap beans under greenhouse conditions. The principal impurities in the spent acid were chlorides and ethyl hydrogen sulfate. On the other hand, similar tests of an experimental superphosphate made with a mixed acid containing 40 per cent of spent acid from the manufacture of acrylic resins indicated adverse effects on snap beans and millet when the superphosphate was applied at high rates (1,000 pounds or more of P_2O_5 per acre).

There are, no doubt, spent acids from numerous other sources that might be used, at least locally, in production of ordinary superphosphate. Manufacturers contemplating the use of such acids should first make certain, however, that the superphosphates produced therewith are not likely to cause injury to crops.

Manufacture of Phosphte Fertilizers Without Sulfuric Acid

About 95 per cent of our present capacity for making chemically processed phosphate fertilizers is based on the use of sulfuric acid in one way or another. As previously mentioned in this paper and as recently discussed by Hill **(14)**, such fertilizers can be produced, however, by several commerically developed processes which do not require sulfuric acid but which thus far have found only limited use in the domestic fertilizer industry.

The processes include the electric- and blast-furnace processes for elemental phosphorus, nitric acid treatment of phosphate rock, thermal defluorination methods, calcination with alkali salts such as soda ash, and fusion of phosphate rock with magnesium silicate. The choice among them involves, along with other considerations, attention to such factors as (1) energy requirements, (2) cost and availability of raw materials, chemicals, and power, (3) plant and processing costs, (4) ease of operation of the process, (5) adaptability of the product to storage, distribution in the field, and inclusion in mixed fertilizers, (6) suitability of the product for use as fertilizer in the intended area of marketing, and (7) the applied-to-the-soil cost of the product to the farmer per unit of available P_2O_5 in competition with P_2O_5 from other sources.

Elemental phosphorus, the primary product of the reduction of phosphate rock by the electric- and blast-furnace methods, can be easily transported and readily converted into a number of concentrated fertilizer materials, such as liquid phosphoric acid, triple superphosphate, the ammonium phosphates, and citrate-soluble calcium metaphosphate. At present, domestic production of electric-furnace phosphorus solely for conversion into fertilizer is confined to the Tennessee Valley Authority. The blast-furnace process has not been operated in the United States since 1938.

Processes for treating phosphate rock with nitrate acid are in large-scale operation in Europe but have not yet been established in this country. They involve neutralization of nitric acid solutions of the rock with ammonia to obtain products consisting chiefly of dicalcium phosphate and ammonium nitrate, or with supplemental additions of potash salts to produce complete mixed fertilizers.

Processes for manufacture of citrate-soluble phosphates by defluorination of phosphate rock in oil-fired units, as well as by fusion of the rock with magnesium silicates (olivine or serpentine), are now in commercial operation in the United States. On the other hand, there is no domestic manufacture of citrate-soluble phosphates by calcining phosphate rock with soda ash, though such products have been made in other countries for a good many years.

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(Continued on page 38)

What Makes Cotton?

By J. Cooper Morcock, Jr.*

Cotton is a key material. War eats it. The military and the public need it; must have it. Consumption is at record levels at home, and our allies are demanding increasing quantities. We need at least a 16 million bale crop this year in the U.S. We must plant it, and somehow we must pick it. So Mr. Morcock's article is timely and vital . . . now.

To meet the National Emergency, the United States Secretary of Agriculture has called for 16,000,000 bales of cotton in 1951. In 1950 the United States produced only 9,884,000 bales.

The results of the Georgia and South Carolina 5-Acre Cotton Contests conducted during two of the worst boll weevil years in History—1949 and 1950—indicate how the Southeastern States do their part toward reaching this goal by producing higher yields of cotton. These contests are conducted annually by the Agricultural Extension Service and are sponsored by the Georgia Cottonseed Crushers Association, the South Carolina Cotton Manufacturers Association, the South Carolina Cottonseed Crushers Association, and other interested organizations.

From the reports submitted by the participating farmers, three practices stand out. When any one of these three practices was neglected, yields were low; when all three were emphasized, yields were high. These essential practices are:

(1) **Large Number of Plants Per Acre**—Illustrated by Chart 1 made from the two-year results from the Georgia contest. Note that those producing 1200 or less pounds of seed cotton per acre had an average number of 17043 or less plants per acre, while the contestants who made in excess of 2000 pounds of seed

CHART 3

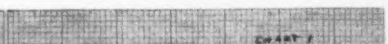

CHART 1

*Agronomist, Southern District

cotton per acre averaged 21951 or more plants on the acre. Various row widths and plant spacings per foot would give this higher number of plants to the acre. A common one would be 36" rows, 1.5 plants per foot, or a plant every eight inches in the row. Another spacing, for tractor farmers, could be 42" (3½ foot) rows with 1.7 plants per foot or a plant every seven inches or two plants every fourteen inches.

(2) **Generous Use of Fertilizer**—This is illustrated by Chart 2 made from the two-year averages of the Georgia Five Acre Cotton Contest. It can be seen that when from 800 to 1200 pounds of seed cotton per acre were produced, the contestants averaged using 44.3 pounds of nitrogen, 50.5 pounds of P_2O_5, and 51.1 pounds of K_2O. This is approximately the amount of fertilizer contained in 650 pounds of 4-8-8, plus 120 pounds of nitrate of soda, or 100 pounds of ANL. Those who produced more than 2400 pounds of seed cotton per acre used an average of 73 pounds of nitrogen, 96 pounds of phosphate (P_2O_5) and 103 pounds of potash (K_2O). This plant food might be obtained by using 1300 pounds of a 6-8-8 fertilizer. Those who produced between 1600 and 2000 pounds of seed cotton (approximately one and one-quarter bales) per acre used 52 pounds nitrogen, 54 pounds superphosphate, and 57 pounds of potash. This amount of plant food might have been obtained from 700 pounds of 4-8-8 with a side application of 160 pounds of nitrate of soda. However, yields of a bale or more per acre would never have been obtained without control of

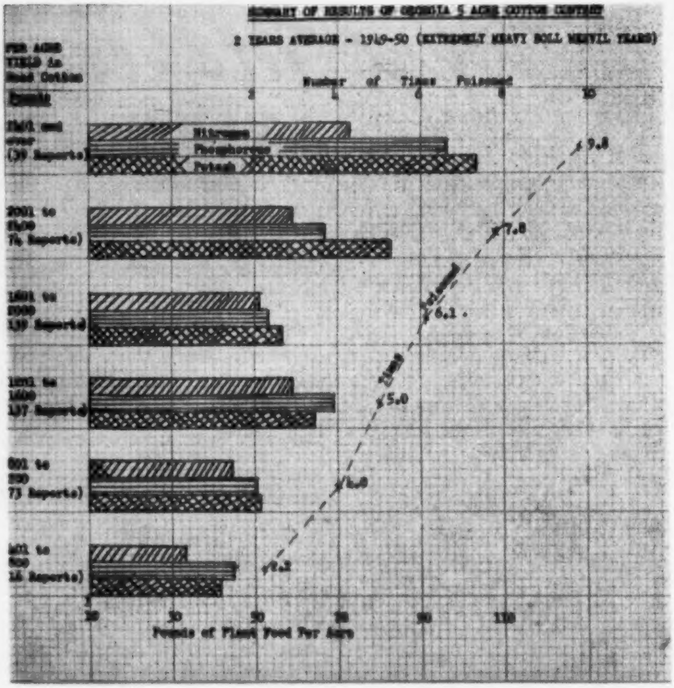

CHART 2

Part of a 55-acre field of Pandora cotton at the Georgia Coastal Plains Experiment Station, Tifton, Georgia. It produced 1-1/4 bales per acre. Per acre fertilizer treatment was 800 pounds of 4-8-8 plus 150 pounds of Nitrate of Soda as top dressing. It was poisoned seven times. The field was planted primarily to increase the supply of foundation Pandora cotton seed, and therefore was planted between April 15th and 20th, which is three weeks later than normal in order to get most of the cotton to open during the normal dry period of that section. It was de-foliated August 22nd, and picture was made on September 1st, 1950.


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SEWN OPEN MOUTH
FLAT SEWN VALVE
PASTED OPEN MOUTH
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the boll weevil. Chart 3 shows relationship between fertilizer applied and yields of cotton under more normal boll weevil infestations. It was prepared from August-1950 "Cotton Production" released by Bureau of Agricultural Economics, USDA. It covers the ten-year period 1939-48.

(3) **Poisoning for Insect Control**—Chart 2 has superimposed upon it a line showing the number of times poisoned. Note that when less than 800 pounds of seed cotton per acre were produced, the farmers averaged poisoning only 2.2 times. Those in the highest-yield brackets (two bales and over) poisoned an average of 9.8 times. It is also interesting to observe that the farmers in the 1601-to-2000 pound bracket of seed cotton used less fertilizer than did those in the 1201-to-1600 pound bracket, but poisoned an average of 5.8 times as against 4.2. Had the farmers in the 1201-1600-pound bracket poisoned an average of seven times, every indication is that their yield would have been above 2000 pounds or in the second bracket from the top. George Jones, Extension Entomologist, North Carolina, at the recent North Carolina Fertilizer Conference, said that in 1950 farmers in that State used 4000 tons of insecticides on cotton, but that 10,000 tons should have been used.

South Carolina Extension Circular 348 reporting on the 1949 5-Acre Cotton Contest said; "The average yield of contest fields receiving no poisoning was 368 pounds per acre. Those poisoning with one to three applications, an average of 465; and those poisoning 4-5 times made an average yield of 507 pounds per acre. The contest fields which were poisoned six times and over had an average yield of 564 pounds per acre." These yields are in lint cotton.

For detailed information on how to obtain prize-winning cotton yields, refer to South Carolina Circular 348, which can be had from H. G. Boyston, Extension Cotton Improvement Specialist, Clemson, South Carolina; or Georgia mimeographed Summary of the 1950 5-Acre Cotton Contest, copies of which can be obtained from E. C. Westbrook, Extension Cotton Specialist, Agricultural Extension Service, Athens, Georgia.

Fertilizer manufacturers and dealers can aid the re-armament program, can help themselves, and at the same time benefit their customers by encouraging their farmer friends to get into the 1¼ to 1½ bale group by:

(1) **Close spacing** their cotton. Chop cautiously.

(2) **Fertilizing liberally.** A minimum per acre application of 700 pounds of 4-8-8 plus 160 pounds of nitrate of soda is indicated.

(3) **Controlling weevils.** Be prepared to poison six or more times.

(4) **Contacting their County Agent**—for information on varieties and cultural and insect control programs, and for information on 1951 Cotton Contests.

Stephens-Adamson Marks 50th Anniversary

Nineteen hundred fifty-one marks the fiftieth year of the Stephens-Adamson Manufacturing Company in the production of materials handling equipment at their Aurora, Illinois plant. Beginning with an 80 by 120 foot building in June, 1901, the main plant now occupies 230,000 square feet, not including the branch plants at Los Angeles and Belleville, Ontario, Canada.

Among the most interesting of the developments they have contributed to materials handling in their fifty years is the zipper conveyor, introduced in 1944, which consists of a rubber belt that forms an endless tube when closed, and carries materials vertically, on inclines, as well as on the horizontal plane.

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(Continued from page 34)

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ALABAMA

International Chemical Corp., Montgomery, plant is in business again. The city authorities had stopped production because of "unpleasant odors" but rescinded the order when they found no serious complaints had come in about it from the public. And the State Department of Agriculture man and the county agent both testified that the plant is a vital industry in a period when greater production is urgent. On their part the International officials promised to confine their use of acid with an eye to which way the wind was blowing.

CALIFORNIA

Sunland Industries Inc., Fresno, have recently added two new units, a liquid fertilizer plant and an ammoniation plant.

David F. Morris, manager of the liquid fertilizer plant, expects to produce 4,000 gallons of liquid fertilizer a day.

J. M. Christensen is in charge of the ammoniation plant, which has been built as an addition to the present fertilizer installation.

Tanks of 500 gallon capacity have been purchased by the corporation and will be placed with distributors as far as Arizona in order to take care of demand.

Dr. G. F. MacLeod, vice-president, said the ammoniation plant is unique in that it uses the anhydrous ammonia rather than water solutions of ammonia and ammonium nitrate, a long established practice in the Eastern and Southern United States. As far as we know, there is no plant like this one anywhere in existence. It was developed by engineers working with Sunland personnel. On the average, it can turn out between eight and twelve tons an hour.

Dr. MacLeod, a graduate of Harvard University, served as head of the Chemical Agricultural Division of the War Food Administration in Washington during the war, after which he joined the Sunland organization.

Sunland was organized in 1930 by **T. L. Harper** and **Beverly H. Jones.**

RED FACE DEPARTMENT

[illegible]

FLORIDA

Davison Chemical, Bartow, have a million man-hours without a lost time accident under their belt, and may be headed for a national safety record for the phosphate industry. **Dr. Allen T. Cole,** manager of the operation for Davison, is pretty proud of the wire he got from the president of the National Safety Council, saluting the completion of the million hours, and hoping they'll make it two million. So far as is known here, that is the first million hour record ever hung up in the phosphate mining field, and Commercial Fertilizer joins in the congratulations. You may remember that Davison were given the National Safety Council Award of Honor last August.

* * *

Naco Fertilizer Co. have opened a farm supply store at Vero Beach, according to **O. C. Minton,** manager of the Fort Pierce plant. **Charles E. Niemeyer** will manage the store, with **Edwin J. Minton** as salesman and **Eddy Dancey** in charge of the parts department. They held a big open house January 20, with a stage show, movies and square dancing.

* * *

University of Florida has listed a $12,000 fertilizer storage and mixing house at Homestead in their capital improvement budget as submitted to the State budget commission. **Dr. George D. Ruehle** of the **Subtropical Experiment Station** says he believes it will simply replace the old fertilizer house at the Station.

GEORGIA

J. A. and **A. S. Mills,** Sylvania, have sold their fertilizer plant, completed last year, and their other agricultural service interests comprising one of the oldest concerns in that part of Georgia, to **H. A. Williams, Jr., J. P. Evans** and **David W. Reed,** who will operate under the style of **Evans, Reed and Williams.** The Mills will continue in farming, realty and livestock.

Around the Map

ILLINOIS

The Illinois Anhydrous Ammonia Co., Farmer City, has opened offices in the Kroger Building, Main Street.

* * *

J. O. Eubank and Sons, Charleston, have opened for business, handling anhydrous ammonia.

MONTANA

Victor Chemical Works, Maiden Rock mine is shipping phosphate rock. This is the first mine Victor has ever operated, but as the rock shipped runs below the phosphate content ordinarily used for superphosphate, observers do not believe Victor is planning a re-entry into the fertilizer manufacturing field.

OHIO

F. S. Royster Guano have acquired a 24-acre tract at Columbus as a fertilizer plant site. Immediate construction had been planned but has been postponed due to the difficulty of obtaining building materials. **C. F. Burroughs,** president, says the plant will be gotten under way just as soon as conditions permit. Royster now operates plants in Alabama, Georgia, North Carolina, Mississippi, Ohio, South Carolina, Virginia and Wisconsin.

SOUTH CAROLINA

Etiwan Fertilizer Company, Charleston, do not believe the explosion and fire which gutted a million dollars worth of plant and material in December will create any shortage of nitrate of soda in that area. **James G. Gibbs,** general manager was quoted as saying they will continue to supply customers. Believed to have been caused by defective wiring, the fire ripped through the company's terminal operations plant December 20, destroying that structure and a string of 21 box cars on a siding.

TEXAS

Williamson County Cooperative Assn., Taylor, has installed a 6000 gallon tank for anhydrous ammonia. **R. W. "Dusty" Rhoades** is manager of the co-op. They will do custom fertilizing, using a four-row applicator and a tractor with a 110-gallon tank.

ASIA

A six-year program designed to raise production and living standards in South and South-East Asia has been published in a report popularly called the **Colombo Plan,** by the seven member countries of the Commonwealth, India, Australia, Canada, Ceylon, New Zealand, Pakistan and the United Kingdom.

The plan had its inception at a meeting of cabinet ministers representing the commonwealth countries in Colombo, Ceylon in January 1950. In May at a second meeting in Sydney, Australia, the member countries were asked to draft respective programs of planned development covering a period of six years. These were submitted for consideration and discussion at the Commonwealth Finance Ministers' meeting in London, September-October, 1950.

India's program involves an expenditure of $3,864,000,000 or about two-thirds of the total sum for the area estimated at $5,230,400,000. Of this sum, India's own contribution is expected to be $2,163,000,000. Nearly $1,701,000,000 will be needed in external aid.

The agricultural program which is expected to cost one-third of the estimated amount will include rural cultivation promotion and instruction, distribution of better seeds and fertilizers, new research and training institutes and local irrigation works besides the major river valley projects.

The plan recognizes the urgent need for technical assistance and proposes to meet it in the following three ways: (1) Expansion of training facilities. It is hoped to raise the number of training institutes from 2,777 operating in 1949 to 3,330 by 1957. (2) Training overseas: India's scholarship scheme of selecting qualified students to study abroad has been reviewed. The program will be continued with particular emphasis on the technical fields. Sixty-five scholarships were awarded during the period 1949-50. (3) **Overseas recruitment:** scientific,

(Continued on page 66)

TRUITT HEADS APFC

Paul T. Truitt, nationally-known trade association executive and businessman, has been elected president of the American Plant Food Council, Inc., the Board of Directors of the organization has announced.

He succeeds the late Clifton A. Woodrum, for 23 years a member of Congress from Virginia, who died October 6, 1950. The Council is a fertilizer trade association composed of companies primarily interested in the manufacture of plant foods used in crop production.

"As president of the Council," Mr. Truitt said, "I shall endeavor to further the organization's aims and purposes with special emphasis on the all-important problem of maintaining, replenishing and increasing the fertility of our soil."

At the time of his election Mr. Truitt was president of the National Association of Margarine Manufacturers, a position he has held since 1943. Previously, Mr. Truitt had been an executive with Sears, Roebuck & Co., and had been an official of the Treasury Department and of the Department of Commerce.

His work with the National Association of Margarine Manufacturers has attracted wide attention in business and government fields and in 1949 the Association, under his leadership, was given the Public Relations News Annual Achievement Award for excellence in public relations programs.

"We feel fortunate," said W. T. Wright, of Norfolk, Va., chairman of the executive committee of the Plant Food Council, "in obtaining the services of an outstanding man like Mr. Truitt. Wherever he has worked, he has built an enviable reputation for integrity, industry, ability and achievement. I know Mr. Truitt is looking forward with zest to helping the membership of the American Plant Food Council aid agriculture. Our job is to help improve the land and to raise better crops. Both are in the public interest, and each is a part of our first line of national defense."

Paul T. Truitt

Mr. Truitt was born in Millersburg, Missouri, on October 25, 1900. He was graduated in 1924 from the University of Missouri where he studied agriculture and business administration. He married Jonnabelle Hunt, of Kansas City, Missouri, in 1928.

He is a member of the Metropolitan Club, the Burning Tree Club, and the Congressional Country Club, of Washington.

CONVENTIONS

NFA: June 11-13; Greenbrier, White Sulphur Springs, West Virginia.

APFC: June 14-17; Homestead, Hot Springs, Virginia.

"Anvil" Booklet Published by NFA

A beautifully printed brochure has been produced by NFA under the title "Making the Anvil Ring" and celebrating the winning of the Silver Anvil, award of the American Public Relations Association. In forwarding a copy to Commercial Fertilizer, board chairman J. E. Totman writes: "As we embark upon 1951 and a new century my greatest wish is that our industry will not only have a successful year, but will also experience another century of progress and service to our nation."

A key quote from the brochure comes on the page headed "The Sights are Set," and follows:

Each year some 10 million tons of the principal plant foods —nitrogen, phosphoric acid and potash—are removed from America's soils in the harvesting of crops and another 40 million tons are lost through erosion and leaching. The amounts returned as commercial fertilizers, manures and crop residues total less than 10 million tons.

Consequently, the continuing objective of The National Ferti-

(Continued on page 66)

FARM CHEMICALS

TCA GAINS IN IMPORTANCE IN CONTROL OF WEEDY GRASS

The chemical TCA (sodium salt of trichloroacetic acid) has not only proved itself a worthy foe of perennial weedy grasses in extensive field trials, but also is showing promise in killing annual weedy grasses in certain TCA-tolerant crops, such as sugar beets and table beets, flax, alfalfa, and other legume crops, according to a report by L. M. Stahler, agronomist of the U. S. Department of Agriculture. Stahler believes that if definite treatment practices and dates can be established by future research, TCA will become one of the farmers' most dependable killers of grass weeds such as quackgrass, Johnson grass and Bermuda grass.

Discussing recent research, Stahler points to several conclusions regarding use of TCA. For one thing, he says, TCA does its damage as it comes in contact with perennial weed roots. Contact with aboveground foliage has little effect on the weed, as the poison is not transferred from the foliage to the roots. Much of TCA's success, therefore, depends on leaching of the chemical down through the soil to root level. This means the poison should be applied at a time of year when soil moisture conditions or rainfall can be counted on to leach it.

The advantage of using cultivation practices along with TCA —especially with quackgrass—has shown up in numerous experiments in the North Central States. In general, a single soil pulverizing cultivation or a turning of the quackgrass sod at least doubled the efficiency of the killer. Cultivation alone kills some quackgrass, Stahler pointed out, and tillage forces quackgrass to give up its carbohydrate content in establishing new roots, a time when TCA has been found extremely effective.

Most efficient rates on quackgrass, Johnson grass, and Bermuda grass have not yet been established, but Stahler reports that the high rates in use a year ago have been proved excessive. Between 100 and 200 pounds per acre were common in 1949 but this last year has seen good results with 40 pounds per acre. The recent investigations indicate that an application of over 80 points per acre is excessive.

Used as an annual weed killer, TAC has been found to control seedlings of green and yellow foxtail (Setaria species), barnyard grass (Echinochloa species) and panic grass (annual Panicum species), without damaging sugar beets and table beets. TCA was applied as a pre-emergence treatment. Pre-emergence treatment also controlled Setaria in flax and alfalfa without damage to the crop. From this initial success further research on controlling annual grass weeds in farm grains and horticultural crops is indicated to be desirable, Stahler said.

Endothal—disodium 3,6 — endoxohexahydrophthalate—is another of the new effective herbicides described by Stahler. Although research hasn't carried as far as with endothal as it has with TAC, the newer chemical has shown promise as an annual grass killer. Tests indicate it may be especially effective in controlling such weeds in canning peas, sunflowers, sugar beets, and sweet clover. It has proved best when used as a preemergence (before the crop sprouted) treatment.

H. Alvin Smith, President of **John Powell & Co., Inc.**, New York City, has announced the opening of new and expanded laboratory facilities in Port Jefferson, Long Island, N. Y., for chemical and entomological work connected with the production and use of insecticides, herbicides and rodenticides.

* * *

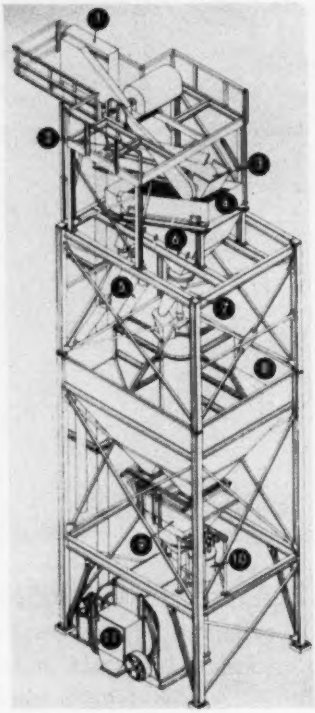
U. S. Industrial Chemicals, Inc., New York, has chosen Kansas City, Kansas as the site of their second plant for the production of Pyrenone Protectants. The plant will have a monthly capacity of 2,500,000 pounds, and will be operated by **Mueller & Co., Inc.**, Kansas City, an associate of **Private Brands, Inc.**

JOHNSON DEVELOPS BLENDING PLANTS

Increased food and agricultural programs are resulting in many stepped-up activities throughout the rapidly-expanding fertilizer industry. Significant of the rising interest in this field is an announcement just received from the C. S. Johnson Company of Champaign, Illinois. Recognizing the essential importance of the fertilizer industry to national welfare and defense, the Johnson firm, manufacturers of construction mix plants and batching equipment since 1921, has now developed several sizes and types of special blending plants and auxiliary equipment for the production of commercial fertilizers.

A typical Johnson installation at a large midwestern fertilizer manufacturing plant combines elevating, pulverizing, screening, batching and blending in one continuous cycle of operation: Electric-powered chain-bucket elevator feeds 1000 cubic feet of material per hour to a clod-breaker, which reduces all material to required size. Self-cleaning belt conveyor carries the pulverized material from clod-breaker to a vibrating, 4 x 10-foot separating screen mounted over collecting hopper. Oversize material is returned via reject pipes from screen back to the bucket elevator and pulverizer for re-sizing.

Collecting hopper, with fast-flowing 60° bottom slopes, feeds the screened material into a full-revolving pivoted distributor, which charges compartments of



1. Chain bucket elevator
2. Clod-breaker
3. Feeder belt
4. Separating screen
5. Reject pipes
6. Collecting hopper
7. Pivoted distributor
8. Sectional bin
9. Weigh batcher
10. Solution batcher
11. Mixing unit

65 cubic yards capacity bin. Constructed of 3/16″ steel plate, the five-section bin has four compartments of 15 cubic yards each, arranged around a five cubic yard central-feed tank. Bottom of the bin also has fast-flowing 60° slopes, with small valley plates in the corner sections to prevent material hang-up.

A two cubic yard multiple-material batcher equipped with large fill valves receives material, as needed, from bin, and accurately weights up to five fine-grained materials on 5,000-pound dial-head scale. Rubber shroud directs batch to a two-ton capacity mixing unit for final blending operation. For adding liquids, this modern Johnson plant also has a 500-pound solution weigh batcher, equipped with over-and-under weigh-beam balance indicator, and vent pipe for carrying off fumes. Manual or fully-automatic controls are provided for plant operation, depending on manufacturer's requirements.

Other allied products developed by the C. S. Johnson Company especially for blending, storage or distribution of phosphate, lime, potash and other fertilizers, include auxiliary bulk storage silos, aeration systems, bin signals, receiving hoppers, undertrack screw conveyors, in addition to many sizes and types of bucket elevators, bins, batchers and clamshell buckets. The Johnson firm, a subsidiary of Koehring Company, Milwaukee, manufacturer of heavy-duty construction equipment, will also continue to supply its standard line of concrete batching, aggregate and cement handling equipment for all phases of building and heavy construction industries.

For more information, or for the name of your nearest Johnson distributor, write to the C. S. Johnson Company, Dept. PA, Champaign, Illinois.

National Joint Committee

The well attended twenty-sixth annual meeting of the National Joint Committee on Fertilizer Application was held jointly with the Power and Machinery Division of the American Society of Agricultural Engineers at the Stevens Hotel, Chicago, on December 18.

Frank W. Parker of USDA pointed out that through good management, coupled with the judicious use of fertilizer, it is possible to take large yields from land and at the same time maintain or improve its productivity. Glenn A. Cumings, also of USDA, reviewed, with the aid of Kodachrome slides, the developments in fertilizer placement machinery. O. C. French of Cornell University discussed experimental fertilizer placement machinery. George D. Scarseth of American Farm Research Association explained the importance of placing fertilizer where it is available to the growing plant with particular emphasis on corn production. D. R. Dodd of Ohio State University presented data from a survey showing that fertilizer pays well when applied to sod crops.

C. H. Mahoney of National Canners Association and J. D. Barnard of Green Giant Company stressed the need for new machinery for fertilizing vegetable crops. Proctor W. Gull of Spencer Chemical Company discussed the advantages and disadvantages in using anhydrous ammonia. M. H. McVickar of NFA and W. H. Johnson of Ohio Agricultural Experiment Station spoke on aircraft application of fertilizers.

(Continued on page 61)

New England's GREEN PASTURES *Program*

By Walter F. Lane

Under the impetus of a plan for wise use of plant food on pasture crops called the Green Pastures' Program, New England farmers are speedily awakening to the profit value of lush pasturelands in successful dairying, for many years the strong plea of the nation's leading agronomists and agriculturalists.

Providing assurance of success in the use of pasture plant food, this program instructs dairymen in (1) A long range plan for its use, (2) Proper amounts to use for best results, (3) Right kinds of seed in right combinations, (4) Skillful management of the grasses and clovers once they are on the pastures.

This contest, for contest it actually is, is stimulating farmers by the thousand to swing from the indifferent or skimpy applications to the use of large and proper amounts of fertilizers for the production of summer-long forage for their stock. Previously barn feeding was necessary from July on.

Much credit is due Ford S. Prince, enthusiastic "pastureman" in the Extension Agronomy Department at the University of New Hampshire, for the start of this plan in 1947 with only 87 New Hampshire farmer enrollees, which by 1950 had snowballed to a total of 3,016 farms participating in the contest throughout the six state area.

This new look in pastures calls for the abandonment to the young or dry stock of the extensive bushy, rocky, so-called permanent pasturelands, and the use of tillage land which is assigned mostly to the dairy herds.

In a scheme like this the fields can be tilled and reseeded when necessary. They are also maneuverable with fertilizer spreaders and other machinery and a minimum of fencing for controlled rotational grazing is needed.

The 1950 New Hampshire Green Pastures' state champion is Harold W. Rodwell. The state winner's 151-acre Kensington dairy farm has 95 acres planted to forage. This land cares for a total of 75 head, 45 milkers and 30 young stock.

Last year these 45 milkers produced 435,000 pounds of milk and 15,500 pounds of butterfat, as against a 1948 record of 350,000 pounds of milk and 14,000 pounds of butterfat. This top dairyman expects his butterfat production this year to be at least 500 pounds higher.

A breakdown of this farmer's forage pattern is suggestive of the trend emerging from the four-year-old Green Pastures' Program. This year he had 44 acres of Ladino clover, 30 acres of mixed Ladino and alfalfa, nine acres of corn for silage, and four acres each of Sudan grass and rye for insurance crops. For the grazing of ten head of either young or dry stock he also rents 60 acres of permanent pasture.

The fertilizer program on this farm, in addition to the use of all the manure produced on the farm, included application of 500 pounds 0-20-20 per acre of Ladino and alfalfa stands, and 8-16-16 at the same rate applied on mixed seedings. He used 200 pounds of nitro-prills per acre on the straight grasslands. Fifty-eight tons of lime and 10 of superphosphate were spread during the season.

In his management practices this champion farmer uses six regular grazing paddocks, which can be expanded to 20 by a simple rearrangement of electric fences. The herd is allowed to graze on one lush stand for about five or six days, then rotated to another stand before the grasses and clovers are cropped too close to the ground. This plan permits each stand to rest long enough to renew the growth of the swards.

An important feature of the pasture's program is the land-clearing campaign. On the Bodwell farm 20 acres have been cleared in the last three years, all of which has been planted to forage. This making of new tillage land is done under the Government Soil Conservation Service Program.

Three judges pick the three top men in each of the six New England states in this improved

pastures' contest. Thus complete data for 1949 as to amounts and kinds of fertilizer used on these 18 farms are made available.

A total of 2719 acres were treated regularly with lime, fertilizer and manure. 1102 cows and 407 young stock were kept on this acreage for a total of 1306 animal units. This figures to about one animal unit on each two acres of land. To do this certainly requires a high fertility of soil.

These 18 farmers bought 1430 tons of lime, or a little in excess of a half ton per acre. Here then is the basis for a good fertility program. Boron is applied if a soil test indicates its need.

In all, 815 tons of fertilizers were used on the 18 farms. This represents an average of 600 pounds per acre of land in feed crops. In the previous year, 1948, the average amount was 500 pounds per acre.

Broken down into the various grades and materials, the totals are:

Materials

Superphosphate	287 Tons
Muriate of potash	46 Tons
Ammonium of nitrate	2.5 Tons

Grades

0-14-14	185 Tons
5-10-10	96 Tons
3-12-12	72 Tons
8-16-16	38 Tons
Miscellaneous	88.5 Tons

Miscellaneous grades include: 7-7-0, 10-10-10, 5-12-20, 5-12-8, 4-12-4, 6-9-12, 3-12-6 and hen manure procured from nearby poultry farms.

This list of fertilizers does not include the manure produced on the farm, although it does include the poultry manure. One ton of poultry manure, according to recent analysis, is the equivalent of one bag of 10-10-10 fertilizer.

If these total purchases are reduced to their plant-food elements to get at an average value for each ton of plant food applied, the figures show an approximate grade of 2-14-10.5 for the whole lot.

It will be noted that the phosphorus content of the average grade is higher than that for potash. This is due to the fact that most of the superphosphate is distributed under Government programs, and perhaps it is easier just now to get phosphates than potash. Then tendency is to balance the phosphates with potash pound for pound which was not quite effected under these conditions.

The primary reason for these farmer's dependence upon fertilizers high in potash and phosphoric acid lay in the prominence of ladino clover and alfalfa in their cropping systems. The record shows that ladino mixtures occupied 55 per cent of the tillage land on these farms, while alfalfa or alfalfa and ladino mixed were found on 20 per cent of the acreage. This means that legumes or legume mixtures grew on three-fourths of the land, and legumes are heavy users of potash and phosphorus, as well as of lime.

Although there is considerable difference of opinion among the top men in the contest as to the effect of nitrogen on the longevity of ladino, it is general practice to omit nitrogen for the first two years or so of the life of the stand, especially if there

Top: Close-up of a field of Sudan grass at the Harold W. Bodwell farm, Kensington, New Hampshire.
Harold Bodwell on right, Harold, Jr. center, and a six-year-old Bodwell future-farmer.

Below: Alfalfa-Ladino clover mixture. Cows feeding in another field of Landino-clover-alfalfa mixture.
In the near foreground, state judges of Green Pastures' contest are standing in an insurance or emergency crop of Sudan grass.

is a larger percentage of ladino in the total forage growth.

Top men in the pastures program are pointing the way to more skillful procedures not alone in the matter of soil fertility, but in other phases which make possible the production of more feed from their acreage. Rotational grazing is the rule. Fields are fenced off in size to feed the herd for one week, which takes the height off the stand just down to a safe comeback level. Usually the sward is clipped after each grazing and at the end of a three week rest period has renewed its growth and is ready for more feeding.

The new pasture system allows fields to be used for either hay crops or for grazing. Generally fields nearer the barn are turned to pasturage, and those farther away are tilled for hay or grass silage. In either case the fertilizing program is quite the same.

This grazing of lush pasturelands has beneficially affected the farmer in lowered grain costs. Whereas in barn feeding grain to milk pound ratios range around 1:4, the ratio in summerlong grazing has dropped to an average of 1:8.6, some farms going as low as 1:28. Various factors affect this ratio; such as whether herds are turned out at night, and what flesh condition the herdsman may wish to maintain.

There is ample proof that the new forage plan has distinct value in the increased milk production and the less need for grain feeding. Do the huge outlays for fertilizers pay off in terms of increased farm income, paid-off mortgages, better kept-up buildings and better living conditions for the farm family?

Complete data on these results are not yet available. But farmers seem to think so, judging from the requests for pasture improvement work under the Soil Conservation Service Program. The New Hampshire record last year was a high average of 22 acres per farm signed up in the Soil Conservation effort. Much, but not all, of this land is to be freed of brush, rocks and trees, readying it for the plow, when it will be seeded and fertilized for more pasture and hay crops.

One encouraging example of good economic results is pointed out by Agronomist Ford Prince:

"Two of the men who have stood at the top in New Hampshire finished paying off large mortgages not more than ten years after they had gone heavily in debt purchasing large farms, and while still in the process of making huge outlays for fertilizer in developing their fields for better pastures and hay crops. Government programs enabled them to make more rapid strides by assisting them with their lime and superphosphate purchases. But they didn't stop there as so many have. They purchased other fertilizers and reseeded their fields to Ladino mixtures, even though sometimes it may have been difficult to purchase the fertilizers necessary to execute their plans."

The fairly complete data here shown presents an accurate picture of the methods on each of these farms, and outlines as well the forage pattern which is now well defined among the leading dairymen in the area. The soil-fertility programs of these men stand out as revolutionary when compared with the immediate past ideas of fertility needs for forage crops. What of the future? Undoubtedly two economic factors will have a bearing, namely: the trend into irrigation, also the continuation of the present trend into more intensive roughage programs.

The tendency to irrigation will necessarily be limited to those farms with an available water supply or where one can easily be made available.

Irrigation presents new problems of fertilization and management. How often to fertilize and how much water to apply are two of the problems as yet not entirely solved. Most farmers who are now irrigating have fertilized lightly after each harvest of hay, also after each pasturing where the animals did the harvesting.

Inevitably irrigation will, as it should, increase the acre amounts of fertilizer needed.

The extremely dry season of 1949, in this area the worst in the 75-year weather bureau records, was a good one to test farmers in feed production and to test the efficiency of crops under these extreme conditions. Naturally irrigation was stimulated and several systems employing sprinklers were set up throughout New England. These installations gave good results as might be expected in a period when the effective rainfall for the three hottest months fell well below five inches.

The contest judges were entirely satisfied that the farmers who used fertilizers in abundance in the drought, made much better pastures and hay crops than did those who were skimpy.

Pioneer grassland farming enthusiast, John B. Abbott, of Bellows Falls, Vermont, who for many years has traveled the New England circuit praising grassland farming as the New England farmers salvation and urging soil tillers to feed their grasses well, that they in turn might feed the cattle well, and be registered in the milk pail, declares:

"No competition from anywhere can down the N.E. dairy farmer, who knows his grasses and legumes, his fertilizer needs, his pasture rotation, and can bottle himself up a good brand of green grass silage to go along with his good hay and such."

Dairymen outside of New England have shown intense interest in the keen competition and gratifying results of the New England Green Pastures' Program, and most of the eastern states as far as South Carolina are now trying the idea out; Kentucky joining in this year with a program.

The potential business expansion for the fertilizer industry and the varied benefits to the dairymen across the nation, with spread of this plan countrywide, will no doubt far surpass any past record.

When the idea has fanned out into other areas, agronomists and leading dairymen will no doubt find, as they have hereabouts, that a Green Pastures' program, when properly organized and executed, is probably the best way yet found to teach the principles of better pastures and forage production and management.

Quaker Oats Establishes Fellowship

Dr. Edward R. Weidlein, Director, Mellon Institute, Pittsburgh, Pa., has announced that The Quaker Oats Company of Chicago, Ill., is the donor of a new fellowship there that relates broadly to research on the utilization of by-products from the manufacture of furfural. Charles E. Colwell (Ph.D., Purdue University, 1950), the incumbent of the fellowship, has the close collaboration of Quaker Oats specialists.

FERTILIZER HELPS CONSERVE SOIL AND WATER IN OKLAHOMA

By HARLEY A. DANIEL
Project Supervisor
Soil Conservation Service, Research
Guthrie, Oklahoma

On page 67 of this issue you will find a plea from H. H. Bennett chief of the USDA Soil Conservation Service, taken from his report to the Secretary of Agriculture. In the light of the urgent need there stressed, this article seems to us of more than usual importance.

The once fertile prairie soils of Oklahoma are rapidly losing plant nutrients and organic matter due to continuous cropping and erosion. As they deteriorate and the need for commercial fertilizer increases many new problems arise. Because, in this semi-arid country, water is still the first limiting factor in crop production. Therefore, for best results, fertilizer must be applied in proportion to the amount of available water present.

This necessitates intelligent land use and good conservation farming. These conclusions are based on results of soil conservation research conducted on the Red Plains Conservation Experiment Station, Guthrie, and the Wheatland Conservation Experiment Station, Cherokee, Oklahoma. These stations are operated by the U. S. Soil Conservation Service and the Oklahoma A. and M. College.

Conservation farming provides for the best and full productive capacity of the land. It is based on our understanding of land capability and nature's methods of developing and managing soil, water and vegetation. The most effective and practical means of such farming consists of a combination of sound land use, water control, soil improvement, crop selection and farm management. Where these practices have been properly applied by cooperators of Soil Conservation Districts severe erosion has been controlled, runoff materially reduced and crop production increased.

Red Plains Soils

The Red Plains Station, at Guthrie, (the first soil conservation experiment station of its kind in the Nation) is located on shallow, sloping, highly erodible soil that is low in organic matter and plant nutrients. It represents approximately 36,000,000 acres of such land in Oklahoma, Texas and Kansas. During twenty years of research grass and other thick-growing vegetation for pasture has been found to be the best and most profitable use for the soils of this kind. Therefore, special emphasis is being placed on the importance of grass and grassland agriculture for erosion and flood control, and livestock production. In fact, the annual runoff water from good grassland was 94 percent less than that from hard fallow soil during the last 20 years on this station. This good vegetative cover also protected the soil from erosion. But some of the more badly eroded soils are so poor that a good grass cover cannot be produced without the use of fertilizers.

Revegetation and Gully Control

Under natural conditions grass re-establishes itself slowly on eroded land. The problems common to this type of land must be overcome for accelerating regrassing on exposed subsoil and unweathered parent materials. Low fertility, poor physical condition of the soil, and lack of moisture and organic matter or biological life are perhaps the most serious.

Low fertility can be corrected by the addition of commercial fertilizers and lime. By growing sweet clover and other legumes the organic matter supply in the soil is built up and available nitrogen is increased. Soil or-

Photo by Ray H. Burley of Oklahoma A. and M. College

This is Austrian winter peas growing on the Wheatland Conservation Experiment Station, Cherokee, Oklahoma. This plot was fertilized with 250 pounds of superphosphate per acre. The per acre yield of peas was 17.6 bushels and wheat the following year made 28.8 bushels. The adjacent unfertilized check plot, however, made only 17.9 bushels of wheat per acre.

ganisms can then thrive. Their activity improves the physical condition of the soil, which is extremely important in obtaining good seedings of native grass.

In regrassing gullied or sheet eroded land, special treatment will be necessary. The first step will be to reduce further erosion and stabilize the seedbed. In some areas it may be necessary to divert the runoff water from the original channels by installing contour furrows or ridges between gullies and above the heads of the gullies. Another part of this process is the installing of vegetative barriers of brush and crop residue, and the plowing and grading down of the bully banks. Then the seedbed is ready for fertilizer and lime as needed and the planting of legumes. After the legumes are established, grasses may be seeded by the seedhay method.

Where this procedure has been followed, the density of the vegetation in the treated gullies was three times more than that of the untreated gullies. Legumes condition the soil for the growth of grass. Sweet clover, during periods of fall and spring grazing, produced about 50 pounds of beef, and then 200 pounds of seed, per acre. Vetch is also being used to improve soils for grass culture.

Superphosphate was applied at the rate of 300 pounds per acre in 1947 to switchgrass, little bluestem and weeping lovegrass on this Station. This treatment will be repeated every third year. One hundred pounds of ammonium nitrate per acre was applied annually. The hay yields of switchgrass and weeping lovegrass were about doubled by fertilization. The fertilized plots of switchgrass also produced approximately 2.5 times more seed than the unfertilized. The same fertilizers, and light disking, increased the hay yield of Bermuda grass 4.2 times, and little bluestem grass 1.6 times.

Beef Production After Revegetation

Proper combinations of lime, mineral fertilizers, legumes and grasses will do wonders for inherently poor, eroded soils. They pave the way to permanent and stable pastures and livestock production on this type of land. Sound development and use of such land controls erosion and provides an opportunity for greater production. Through this type of conservation, much of the shallow, eroded land can be converted into profitable pastures and meadows, and satisfactory returns obtained.

During the past six years of summer grazing, yearling steers on severely eroded, unfertilized land produced an verage of 40 pounds of beef per acre. But beef gains on regrassed, eroded land can be increased by fertilization. When phosphorus and nitrogen fertilizers were applied to regrassed land in the spring of the last three seasons, beef production the following summers was more than doubled.

The grass is KR bluestem (**Andropogen ischaemum**) growing on the Red Plains Conservation Experiment Station, Guthrie, Oklahoma.
The plot on the right was treated with 300 pounds of superphosphate and 100 pounds of ammonium nitrate per acre in the spring of 1950. The plot on the left was not treated. The fertilized plot produced 5.8 times more grass than the unfertilized area.

Photo by Soil Conservation Service

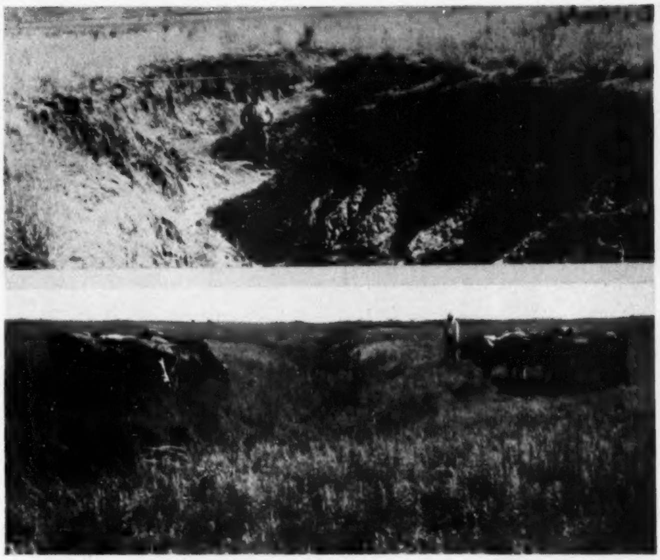
Cropping Systems and Fertilizers

The most effective and practical methods of erosion control yet developed for growing cultivated crops probably include: A well planned system of terraces; contour cultivation; fertility treatments; and cropping systems. The exact combination of these practices, however, must be determined by the various soil capabilities and climatic conditions where they are applied.

A rotation of cotton, wheat and sweet clover has been studied on the Red Plains Station during the past 20 years. It has reduced soil losses 74 percent and runoff water 34 percent annually as compared to continuous cotton. Both the wheat and sweet clover greatly reduced erosion, but the amount of soil removed from the wheat plot was six times more than that from sweet clover.

This experiment was started on virgin soil broken out of native grass sod in 1929. The yield of cotton in the rotation the first and second five-year periods was less than that on the continuous area. During the last 11 years, however, this rotation, and small quantities of phosphate fertilizer, has increased the yield of cotton 1.89 times. Another interesting fact about this experiment is that cotton production was increased 2.98 times the last five years of this period, and 3.11 times in 1948 and 1949. Winter covers of vetch, together with mineral fertilizers, have also doubled the yield of cotton during the last 18 years.

Close-growing cultivated plants that produce protective land cover during the months of heavy rainfall are especially valuable in conserving soil and water. Sixty percent of the annual precipitation at this station was received during the months of April, May, June, August and September; but an average of 77 percent of the total runoff water was lost in this period. July rainfall is usually low. Therefore, thick-growing vegetation and other conservation measures are most useful during the spring and fall months. Fertilizers are especially valuable during these periods. They increase plant growth and produce a better land cover. Soil erosion from small grains was reduced one-half by the use of fertilizers the last four years on the Conservation Experiment Station in Missouri.

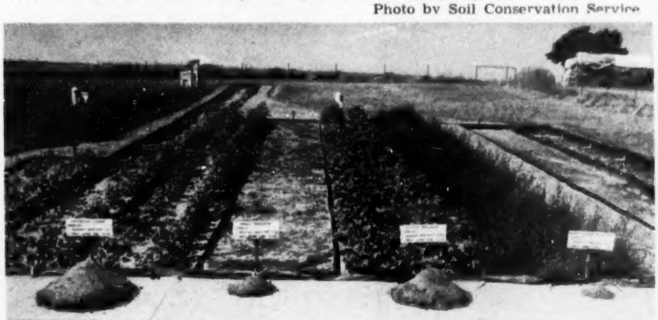


Many additional cattle can be pastured on gullied and eroded land by applying proper conservation practices. (A). A gully on the Red Plains Conservation Experiment Station, Guthrie, Oklahoma, before treatment. (B). Same gully after the banks were sloped, brush, mulching material and fertilizer applied, legumes grown and native grass established from seed-hay mulch.

During the last three years of summer grazing, yearling steers on severely eroded unfertilized land produced 40 pounds of beef per acre. But production can be increased by fertilization. Where the equivalent of 100 pounds each of superphosphate and ammonium nitrate were applied annually an average of 88 pounds per acre was produced during the same period.

The piles of soil represent the average annual amount of erosion from the different crops in the rotation since 1930, at the Red Plains Conservation Experiment Station, Guthrie, Oklahoma. Pile 1, on the left, represents 16.254 tons per acre and was from continuous cotton, while Piles 2, 3, and 4 were 2.228, 8.688 and 0.325 tons per acre and from the respective crops of wheat, cotton and sweet clover in the rotation. The sweet clover was fertilized with 250 pounds per acre of superphosphate.

Photo by Soil Conservation Service



Wheatland Soils

The Wheatland Station at Cherokee is located on rolling, deep, permeable soil in the heart of the wheat area that is typical of Oklahoma and Kansas. Its objective is to discover and design means of conserving moisture to reduce the possibilities of floods, and to increase plant growth. Therefore, when it was established in 1939, the particular site was selected because of the fertile, favorable soil conditions. But it is rapidly losing organic matter, which is a valuable aid in soil and water conservation. Therefore, recent studies are showing that even this good wheatland is beginning to respond to fertilizers.

But since water is usually the first limiting factor in crop production, it is highly important that the best possible method of conservation farming be used. Terraces and contour cultivation are especially useful on deep sloping soil. They reduced the runoff water losses 40 percent annually the last seven years on this station. This was stored in the soil for plant use and did not contribute to the flood waters of the local streams. The water that did leave the field, moved slowly and carried only small quantities of soil. Water allowed to flow swiftly carried large amounts of the soil.

Use of Fertilizer to Improve Ground Cover

Stubble mulch culture has been valuable for preventing erosion and reducing runoff. However, the relatively low yields from the plots tilled in this manner indicate that other treatments may be necessary if stubble mulch is to be widely adopted. Therefore, an effort was made to increase the growth of small grain and produce a better land cover by applying various amounts of fertilizers. The first application was made in March 1945, and, in general, the wheat responded slightly to small amounts of ammonium nitrate. The greatest increase appears to be on the stubble mulched plots.

The best results, however, have been obtained from a combination of superphosphate and nitrogen fertilizers or superphosphates following winter legumes. Superphosphate was applied at the rate of 250 pounds and ammonium nitrate at 100 pounds per acre respectively. During the last four years, superphosphate alone increased the yield of wheat one-fourth and the combination of superphosphate and ammonium nitrate increased it more than one-half.

The importance of fertilizers and legumes are well emphasized. The increased production of straw eventually adds more organic matter and develops a better land cover. The wheat receiving phosphours made a more rapid growth in the spring at the time when erosion is more severe and matured earlier. The legume residue also produces a valuable erosion control mulch.

Fewer Floods and More Jobs With Soil Conservation

Fewer floods and jobs for more people can result from a complete application of these soil conservation research findings. When measures of this nature are applied to the watersheds of rivers, they will be most effective in the control of floods. This type of sound land use and practical conservation farming will also control severe erosion and stabilize income. It gives the farmer an opportunity to convert his forage feeds and pastures, which would otherwise be wasted, into finished products of meat and milk. It also provides year-round employment for the family and a profit on his investment. If proper soil conservation and improvement practices were applied to all farms additional thousands of people could be employed, not only in farming, but in agricultural processing plants (lime, fertilizer, dairy, crops, vegetables, berries, fruits, etc.). This improvement would create extra business, schools, churches, better roads, etc. In this way the soil is saved for the building of a world of greater abundance and opportunity.

In fact, Louis P. Merrill, Regional Director of the U. S. Soil Conservation Service, Fort Worth, Texas, says that this research, and work of the Soil Conservation Districts in Oklahoma, Texas, and Kansas, is so outstanding and revolutionary it is practically the equivalent of discovering about seven million acres of new land. Furthermore, H. H. Bennett, Chief of the Soil Conservation Service, has said, "This and other soil conservation research in the Nation has laid the foundation for a new pattern of agriculture." He says that, "It also paves the way to permanence and stability of the whole agricultural industry." Sound development

and use of agricultural land resources will preserve national resources, maintain more abundant living, reduce floods, prevent impairment of reservoirs, maintain the navigability of rivers and harbors, and protect public health.

PASTURE

(Continued from page 19)

seeded with a mixture of eight pounds of bromegrass, eight pounds of alfalfa, three pounds of red clover, and two pounds of Ladino clover per acre. The renovated pastures were cultipacked after seeding and received no other treatment during the 5-year period except for another 500 pounds of 0-14-14 fertilizer in the spring of the second year.

For comparison purposes, a part of each original pasture was not renovated, but received the same fertilizer treatment as the renovated pastures.

The average yield in pounds per acre of total digestible nutrients from the renovated pastures was: First year, 2,016 pounds; second year, 4,155 pounds; third year, 3,967 pounds; fourth year, 4,142 pounds; and the fifth year, 3,797 pounds. The 5-year average per-acre yield for the renovated pastures was 3,617 pounds of total digestible nutrients as compared with 2,687 pounds for the unrenovated pastures,—or an increase of 930 pounds of total digestible nutrients per year.

This increase, which amounted to 35 percent, is equivalent to 1,860 pounds of good hay, and is about equal to the total production of feed nutrients from many pastures of low soil fertility.

JOINT COMMITTEE

(Continued from page 47)

M. H. Lockwood of International Minerals & Chemical Corporation pointed out that in his opinion there would be both an increase in the plant-food content of fertilizers and an improvement in the physical condition. C. E. Guelle of International Harvester Company and W. A. Hyland of Van Brunt Manufacturing Company pointed out the difficulty in making machinery which would apply uniformly all of the different fertilizer materials.

All papers will be published in the Proceedings of the National Joint Committee on Fertilizer Application which should be available within the next two or three months.

MARKETS

Tax Tag Sales Record Broken

New fertilizer tax tag sales records are assured for 1950. Sales for the first 11 months in 1950 have exceeded the full year of 1949 by 224,000 equivalent tons. December figures from 12 of the 14 reporting States show an increase of 40.3 percent over December, 1949.

January-November figures for the 11 southern States and three mid-western States add up to a bit over 10,000,000 equivalent tons. This is an increase of nine percent over the like period last year.

Gains were registered during the fertilizer year to date. July-November figures show a gain of 23 percent in the South, 18 percent in the Midwest and 21 percent for the whole group over comparable 1949 figures.

FERTILIZER TAX TAG SALES AND REPORTED SHIPMENTS
(In Equivalent Short Tons)
Compiled by The National Fertilizer Association

STATE	December		January-November		July-November	
	1950	1949	1950	1949	1950-51	1949-50
Virginia	6,488	26,773	663,842	655,642	152,060	161,655
N. Carolina	1/	68,473	1,708,744	1,449,984	283,950	189,098
S. Carolina	94,856	52,404	918,970	910,312	213,355	147,740
Georgia	62,248	44,927	1,173,510	1,188,708	217,205	172,286
Florida	120,795	126,073	976,573	858,019	406,425	342,555
Alabama	59,025	29,581	992,284	1,012,788	167,989	135,936
Tennessee	16,316	13,691	475,940	448,084	103,202	87,352
Arkansas	22,201	18,050	343,862	316,545	53,732	49,368
Louisiana	13,226	10,590	265,482	230,999	61,001	45,854
Texas	37,877	28,036	549,762	477,461	218,232	187,613
Oklahoma	1/	3,330	137,430	122,198	49,118	51,188
TOTAL SOUTH		421,928	8,206,399	7,670,740	1,926,269	1,570,646
Indiana	148,725	98,264	812,928	672,475	347,439	307,155
Kentucky	76,175	53,710	530,995	437,006	131,588	112,337
Missouri	72,885	18,664	483,010	435,727	190,295	149,320
TOTAL MIDWEST		170,638	1,826,933	1,545,208	669,322	568,812
GRAND TOTAL		592,566	10,033,332	9,215,948	2,595,591	2,139,458

1/ Not available for this issue.

ORGANICS: Fertilizer organics are in tight market position with the producers of domestic Nitrogenous Tankage sold up for the balance of this season. Nitrogenous Tankage prices are nominally $4.50 to $5.00 per unit of Ammonia in bulk f.o.b. origin. Imported organics are relatively scarce and prices are around $6.00 to $6.50 per unit of Ammonia in bags exvessel Atlantic ports for Nitrogenous Tankage.

CASTOR POMANCE: Current quotations for domestic production are at $5.50 per unit of Ammonia in bags, f.o.b. Northeastern production points. This is for material guaranteed minimum 5.75% Ammonia.

DRIED GROUND BLOOD: The Chicago market is around $9.25 bid and $9.50 per unit Ammonia asked. The New York market was last traded at $9.50 f.o.b. New York area.

POTASH: Demand continues heavy and shipments steady against contracts, hampered only by occasional boxcar shortages. Prices continue unchanged for domestic material. Several cargoes of Imported material are due to arrive in February at Atlantic ports but this is understood to be all under contract.

GROUND COTTON BUR ASH: This excellent source of Carbonate of Potash continues in limited supply position. Some supplies are available, however, for Spring shipment testing 30/40% K_2O Potash.

PHOSPHATE ROCK: The market position continues firm with demand steady against domestic contracts.

SUPERPHOSPHATE: There are practically no surplus supplies of normal Superphosphate and market is generally tight throughout the entire consuming area. Triple Superphosphate is in heavy demand and far in excess of supply.

SULPHATE OF AMMONIA: This market is tending to tighten as demand increases against existing contracts. Very little surplus material is available. Prices continue firm at previous levels.

AMMONIUM NITRATE: Demand far exceeds supply and some areas are evidencing shortages. Prices continue firm with a tendency to rise.

NITRATE OF SODA: Effective January 1 the price was advanced to $53.50 in bags for Imported material at Charleston. This represents an advance of $2.00 per ton. Domestic Nitrate of Soda is priced at $48.50 f.o.b. Hopewell, Virginia and $51.50 f.o.b. cars in bags at Charleston.

GENERAL: Practically all major fertilizer ingredients are in tight supply position, with Superphosphate currently short of demand due to reduced production of Sulphuric Acid.

Fertilizer Handling Part of Chicago Show

Many problems of materials handling in the fertilizer industry will be considered at the Materials Handling Conference which will be held concurrently with the National Materials Handling Exposition at the International Amphitheatre, Chicago, April 30-May 4, inclusive.

Mostly Personal

Clarence E. Elsas has been elected president of **Fulton Bag & Cotton Mills**, Atlanta, succeeding the late **William R. Elsas** (CF January). At the same meeting, in addition to re-election of executive officers, the following elections took place: **Eugene A. Cronheim**, secretary-treasurer, became vice-president and secretary; **Julius B. Cronheim**, manager of the St. Louis plant and a director, was named vice-president; **George L. Brogdon**, who has been comptroller, was made treasurer. Three new board members were also elected: **E. Monroe Hornsby**, manager of the New York office; **Norman D. Cann**, attorney, and for a number of years counsel to Fulton Bag; **Frederic G. Barnet**, a great grandson of **Founder Jacob Elsas**, and presently with the Fulton Dallas plant.

* * *

C. V. Martin has been made assistant director of purchases for **Davison Chemical**, and is in charge of priorities and material expediting.

* * *

John Kolb McIver, sales director of **Southern States Phosphate and Fertilizer Co.**, Savannah, Georgia, was married December 26 to Jessie

W. L. Jenkins, appointed by The Barrett Division as sales representative in 37 counties in western North Carolina for Arcadian nitrate of soda.

Antoinette Cordson of Savannah, in Tallahassee, Florida.

* * *

W. D. McLean, assistant director of the **Bemis Bro. Bag Co.** jute department, recently returned from a five week trip to India and Pakistan, where he participated in conferences with officials of the Indian government and with representatives of the jute industry which led to an allocation system which it is hoped will provide increased burlap supplies for the U.S. during 1951. This is Mr. McLeans second trip to India within a year, the primary purpose of which was to get more burlap for U.S. users. Mr. McLean is now in demand among lunch clubs as a speaker on India.

* * *

T. R. Mangelsdorf is sales manager of the Omaha Sales Division of Bemis Bro. Bag Company plant

William H. English, Jr., former president of the New York Coffee and Sugar Exchange and trustee of the Franklin Savings Bank, has been admitted to partnership in H. J. Baker & Bro., 100 year old fertilizer and feed materials firm.

at Omaha, Nebraska. He joined Bemis in November, 1942 as a salesman at Omaha, and has remained there since that time.

* * *

Frank J. Danner, for more than 25 years general traffic manager of **Chase Bag Company**, has retired. He will be succeeded by **A. P. Ellerbrock**, assistant to Mr. Danner during his entire period with the company.

Harrison B. Rue, in charge of Chase Bag Company's Memphis Sales Office for the past four years, has been appointed Sales Manager of the Company's Buffalo, N. Y. Branch.

Mr. Rue's successor at the Memphis Sales Office will be **H. J. Uldricks** who was transferred from the Chase Branch in Philadelphia.

Davison Chemical has advanced these men as follows: 1. Marshall C. Roop, elected vice-president-finance, a newly created post, capping his 25 years of service. 2. J. Early Hardesty, elected treasurer. 3. Norman E. Hathaway, now general sales manager-industrial division, with Davison since 1946., he succeeds . . . 4. R. D. Goodall, who has become assistant to the vice-president-marketing, and has been with the company since 1939.

Changes at U. S. Steel's Coal Chemical Sales Division, Commercial Department: 1. John V. Freeman, retiring as director of the division after 43 years of service. 2. Charles W. Baldwin who succeeds him. 3. John W. Clinton, assistant director.

A Letter from Littlejohn

Believe it or not, this is Ray "Cabinas" Ellis . . .

On July 4th, '50, he was caught in this state of . . . Yes, the French have a word for it . . . "Deshabille" . . ., when Colonel Ellis, Wiley to you, just after breakfast on the front porch at Silver Hills, was checking over mobilization plans for his regiment, Ex-Corporal Ellis of the '98 Campaigns in Cuba decided that he too had to be mustered in . . . So, he rushed up-stairs to the attic, got down his Original '98 Blues, went thru several contortions of Yogi in transferring chest in the abdominal regions back up-stairs to where Nature had originally placed it . . . he finally got the last button hooked . . . But . . .

He forgot his britches . . .

And, hence the polka-dot pajama trousers. This one was too good to let pass without a record . . . So, Wiley shot the picture. One old friend in Indianapolis said . . . "Wiley should have shot Ellis, Ex-Corporal Ellis, That is" . . .

All of us out here in the mid-west, who have seen this exposure, have had a good laugh out of it, and am passing it along for the rest of the Industry to enjoy.

C. E. Littlejohn,

P.S. . . . Some time around the Conventions, Ask "Marty" or Charlie Rauh, how Ellis got the Name of "Cabinas" . . . That is one for the books too.

R. U. Haslanger has been made manager of the newly-created sales department of **Monsanto Chemical's** Texas Division at Texas City. He has been with them since 1939.

* * *

Melvin H. Baker, president of **National Gypsum,** Buffalo, has been named by the Buffalo Evening News as one of 12 outstanding Buffalonians of 1950. He received a certificate for Industrial Statesmanship at the Mid-Century Boston Jubilee, was cited by the University of Buffalo's School of Business Administration as "the Niagara Frontier's outstanding businessman, was 1950 chairman of the Christian committee for the United Jewish appeal and was active in numerous other charitable and civic organizations.

* * *

D. W. Brooks, manager of the **Cotton Producers Association,** Atlanta, has been named "Man of the Year in Agriculture by **Progressive Farmer** magazine.

J. Benjamin Cowan, who has been promoted to executive vice president of Plasteel Products Company, Washington, Pennsylvania. He has been with them since 1945.

ASIA

(Continued from page 41)

technical and educational experts will be recruited from abroad. India has already signed agreements with U.N.E.S.C.O. and F.A.O. which provide for the assistance of technical experts.

Such assistance will be supplemented and coordinated through the efforts of the Council for Technical Co-operation which was set up by the Sydney Conference. The Council is composed of representatives of the participating countries and will have its headquarters in Colombo. It will cooperate with all U. N. and other organizations in acting as a clearing house for requests for technical assistance and in channeling pertinent information.

The report points out the urgent need for supplemental external aid and notes the growing field for private investments and measures now being taken to encourage foreign capital.

It concludes: "Without external financial assistance something will be done. But it will be done at a much slower rate than would be possible if external finance were provided.

"And speed is necessary. In a word racked by schism and confusion it is doubtful whether free men can long afford to leave undeveloped and imprisoned in poverty the human resources of the countries of South and South-East Asia which could help so greatly, not only to restore the world's prosperity, but also to redress its confusion and enrich the lives of all men everywhere."

NFA

(Continued from page 42)

lizer Association during the 50 years of its public service has been to narrow this wide gap between removal and replacement of plant food—to reduce the huge annual overdraft on our plant food bank account—through proper and adequate use of fertilizer on our Nation's farms. In addition to playing a large part in conserving our soils for future generations, such use promotes sound agriculture in its broadest sense. Widespread recognition of these contributions serves two purposes: First, by encouraging increased fertilizer use, it broadens the area receiving fertilizer's benefits; second, by building a stable demand for fertilizer, it favors the continued and healthy growth of a vital industry.

Soil Conservation Speed-up Urged

The importance of soil conservation to national defense was emphasized today by H. H. Bennett, chief of the Soil Conservation Service in his 1950 fiscal-year report to the Secretary of Agriculture. The report records accelerated conservation progress for the sixteenth straight year. It terms modern soil conservation which treats and uses the land according to need and capability, "an indispensable part of our first line of national defense."

"It seems to me," Dr. Bennett said, "that the very uncertainty of the world's political, economic, and military situations makes it imperative that we speed up our conservation work. In the near future, we must be able to say that our agricultural plant is stable and that its capacity for production, as far as we can see ahead, can be expanded to meet any anticipated needs without danger of serious damage to our future productive capacity."

To that end, the report sets as the Service's goal, completion of at least an average of four percent of the remaining conservation job on United States farmlands each of the next three fiscal years, working through farmers' soil conservation districts. That compares with 2.7 percent of the total remaining job done in the 1950 fiscal year. The soil conservation head expressed the belief that, with adequate facilities, the job of applying the basic conservation measures to the land could be completed in about 20 years, after which would remain the continuing task of maintaining the conservation improvements.

By June 30, 1950, the report shows, 18. 6 percent of the conservation job had been completed, in addition to a considerable spread of unrecorded practices to farms both within soil conservation districts and outside. That is about one-fifth of the total job. In the 1950 fiscal year alone, basic conservation measures were applied to 26,071,342 acres. This was described as an increase of 388 percent—nearly five times as much work done—over 1942, for example, with operating facilities increased during this 8-year period by only about 50 percent.

"In addition to the conservation measures applied to the land," it was pointed out, "much farm planning work was done and enough soil conservation surveys were carried out for a healthy backlog of necessary conservation farm plans."

The report gave an accounting of accomplishments in soil conservation districts with assistance of the Soil Conservation Service, for the fiscal year and through June 30, 1950.

FISH POND FERTILIZATION

Principals in the fertilization project carried out at Crooked Lake, in the National Forest near Astor Park, Florida, prepare to make a test seining. Left to right are: Floyd Eubanks, assistant Lake County agent; Dr. B. R. Fudge, chief horticulturist of the Wilson and Toomer Fertilizer Company; Robert Norris, Lake County agent; Howard Bissland, biologist with the U. S. Department of Agriculture: Walter Shaffer, U. S. Soil Conservationist, and Wyatt Carpenter, soil conservation service aide.

By Harris Samonisky

Folks who raise corn, cabbage and citrus in the lush area around Astor Park, Florida, on the border of the national forest —and who have seen a "dead lake" come to life—are prepared to switch from agriculture to pisciculture.

Their forefathers taught them that, through fertilization, they could grow lustier crops and even raise thousands of juicy steaks per acre of land. But their forefathers didn't know — and neither did they until recently —that the same principal applies to fish.

"The fact is," commented Dr. B. R. Fudge, for 18 years associate biochemist with the Citrus Experiment Station, University of Florida, and now chief horticultrist for the Wilson & Toomer Fertilizer Company, Jacksonville, "where we used to use fish to make fertilizer, now we're using fertilizer to grow fish."

Some startling facts and figures have been revealed by biologists and conservationists who for the past year have been conducting an experiment in lake fertilization at Campa McQuarrie, near Astor Park. Crooked Lake, a 32-acre body of water which, a year ago, yielded an occasional black bass which would be so undernourished it was hardly fit to eat, is now apparently teeming with fat and sassy bass.

A federal biologist estimates that the lake, which would normally yield 20 to 30 pounds of fish per acre, may average 700 pounds of fish per acre before the program is completed.

It all started back in May of 1949 when Howard Bissland, biologist for the Soil Conservation Service, United States Department of Agriculture, was giving some 4-H lads instructions in soil conservation at Camp McQuarrie, which is on Crooked Lake. Bissland was discouraged by the seeming lack of fish in this crystal clear lake and he suggested to Bob Norris, agricultural agent for Lake County, that fertilization might help.

Norris, an outstanding veteran county agent who has been instrumental in the development and success of Camp McQuarrie as a 4-H Youth Center for Central and South Florida, called his old friend, Dr. Fudge. Dr. Fudge was enthusiastic over the

idea and his firm agreed to contribute the fertilizer.

With the assistance of Soil Conservation Service technicians from the Lake Soil Conservation District, on May 20, 1949, three tons of fertilizer were scattered in the lake. Additional applications were made each month after that until by June 1950, a total of sixteen tons had been deposited. U. S. Department of Agriculture Forest Service agents assisted in the project.

"Prior to fertilization," said Bissland, "Crooked Lake supported little plant growth. A few months after fertilization began, chlorophyllous plant life began growing around the edges of the lake. Plankton, the small animal and plant organisms that float or drift in the water and are basically essential to small fish, reproduced rapidly. The color of the water changed from clear blue to greenish blue.

"A year ago, at daybreak, the surface of Crooked Lake would be as smooth as a mirror on a calm day. Today, it is alive with leaping fish. We have evidence to prove that the fishing is really good and steadily improving. We'll have a more conclusive report to make in another year."

Just a year from the day fertilizer was first introduced to the lake, Bissland and his associates made several seining tests. They found a good reproduction of Bluegill and fingerling black bass in the net on each dip. This test, Bissland said, shows that the lake is in good balance and that nature is doing an excellent job of reproduction—with the aid of fertilization.

"Jeff Hills, field representative for the fertilizer company, said he recently made one round of the lake in a skiff, at high noon and with a hot sun. It took him 30 minutes. He returned to the docks with seven black bass, averaging about a pound and a half apiece. Adam Niskanen, veteran caretaker at Camp McQuarrie, says that a number of ten and 12 pound black bass have been taken from the lake in recent weeks. Only last week, the 4-H boys at Camp McQuarrie caught enough bass and bluegills in a single day to feed 140 people at a fish fry.

"The normal yield of a lake this size," Bissland said, "is

twenty to thirty pounds of fish per acre. Through fertilization, properly directed, we can kick up this average to seven hundred pounds per acre. That sounds incredible but I have facts and figures to prove it.

"One of the reasons for this tremendous increase in yield is because here in Florida we have a twelve month growing season. The waters of our inland lakes rarely become cold enough to retard fish growth.

"Sportsmen are keenly interested in this program because it is highly important that a fertilized lake be regularly fished in order to maintain balance. Furthermore, a well-fed bass feels his oats. He gets ornery and he'll strike at almost anything that drifts past him. Undernourished fish—which was all the lake used to have—are listless. If this lake hadn't been properly fertilized, it would have been just a question of time before the predatory and worthless fish took over."

Bissland said work in fertilization is being conducted in about 500 acres of managed ponds and lakes in Florida.

"And when you consider," added Dr. Fudge, "that we have more than 30,000 lakes in Florida you can readily see how important a program like this could become—both from a sporting angle and an economic standpoint.

OBITUARIES

Boyd "Pat" Daugherty, who five years ago retired as head of the Bemis Bro. Bag Co., New York sales office, and who had been with Bemis since 1913, died in New York December 30.

Mrs. James W. Dean, 80, wife of the president of the Knoxville Fertilizer Co., died December 28 in Fort Myers where she had gone in an effort to regain her health. The Deans had been married 45 years.

Ben J. Sallows, 62, who organized Union Potash and Chemical Co. at Carlsbad, former publisher of the Alliance, Nebraska, Times-Herald, died December 17 of leukemia.

Douglas Beveridge Seabury, manager of the Farm Fertilizer Production Company, Omaha, Nebraska, died December 26 in Savannah, Georgia, where he was visiting relatives.

Effect of Potassium

ON ORANGE FRUIT SIZES

Fertilizers which supply potassium to the soil increased the size of orange fruits during a long-term fertilizer experiment at Riverside.

A relation between fruit sizes and potassium supply had not been recorded before in California where the citrus soils contain relatively large amounts of potassium. Considerable quantities are also supplied by the application of manure and other bulky organic materials which are widely used in citrus fertilizer programs.

Fruit-size increases following potassium applications have been observed in experiments in sand cultures and in field trials conducted in Florida and in foreign countries. Those experiments—conducted under conditions of severe potassium deficiency—gave small yields as well as small sized fruits.

Reduction in yields were not found in the Riverside trials—where no symptoms of potassium deficiency were observed on the leaves or twigs of the trees. The size of the oranges apparently is a very sensitive index of the potassium supply.

The increases in fruit size in the Riverside experiment were obtained by applications of sulphate of potash and of manure or other bulky organic materials. The use of the bulky organics gave greater yields because such materials create more

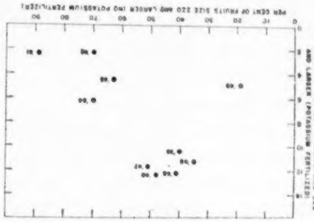


Fig. 1. Relations in the crops harvested 1939-1949 between the average annual increase in the size of the fruit, due to fertilization with sulfate of potash, and the average size of the fruit of trees which did not receive this fertilizer. The 1949 crop suffered damage by pests, wind and frost. Data are expressed on a volume basis.

favorable soil conditions as well as supply potassium.

The experimental trees are of the Washington navel variety on sweet orange roots, planted in 1917. The fertilizer experiment was started in 1927. The soil, which previously had not been fertilized, is classified as Ramona loam.

The effects of potassium supply on fruit size were studied in plots which received sulfate of potash. Leaf analyses confirmed the relations between fruit size and potassium in a large group of fertilizer treatments.

The packing house grades and sizes of the fruit of all of the treatments were obtained in 14 crop years. The fancy and choice grades were sized in 1931-1934.

In 1939-1942 and 1944-1949 all of the grades, including the standards, culls and rots, were sized. When necessary, the fruits of the lower grades were measured by hand. Thus a count of all fruits and their grades and sizes was obtained since 1939. The fruit sizes were summarized as the percentage of the total volume of fruit which was of size 220 or larger—220 or fewer fruits per packing box.

Sulfate of Potash Fertilizer

The effects of added potassium on fruit size were determined by comparing the fruit of paired treatments. Five replicated treatments which received sulfate of potash were compared with five which did not receive this fertilizer. The paired treatments were similar in other respects. No organic materials were used in this series of treatments. Generally one pound of potash was

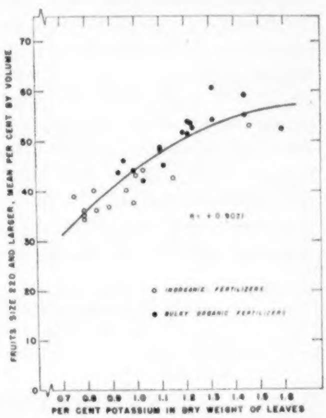


Fig. 2. Relations between the average size of the fruit—expressed as the percentage of fruits size 220 and larger, by volume—of the crops harvested 1946-1949 and the potassium content of the dry matter of leaves sampled in December, 1948. The matter of leaves sampled in December, 1948. The data are for trees which have received various fertilizer programs.

From "California Agriculture" MonthlyBulletin of U of C College of Agriculture.

applied each year to each potash-fertilized tree. The percentage of large sizes was usually greater for the fruit of the trees which received the potash fertilizer.

During the early years of the experiment—1931 to 1934—the effects of the potash fertilizer on fruit sizes were small and inconsistent. They could have occurred by chance. In later years potash caused increased size of fruit, but the increases varied in magnitude.

In the crops picked in 1939 and 1940 the increases were appreciable. At that time the trees were affected to a moderate degree with nitrogen deficiency. It was first thought that this deficiency influenced the results, especially since the rate of nitrogen application was increased in 1940 and small effects of potash occurred in the crops of 1941-1945. However, in 1946-1948, potash applications increased fruit size appreciably. The nitrogen theory was therefore abandoned. In 1949 the effect of potash was again small but this crop was damaged by pests, winds and frost.

Leaf Composition

A study of the annual effects of potash applications on fruit size suggested a reason for the variations which were observed. The increases were compared with the average size of the fruit harvested in the same season from the check trees which received no potash fertilizer. Excluding the 1949 crop, it was evident that the fertilizer caused greater increases in fruit size in the years when the fruit of the check trees was small. When the fruit of the check trees was large, the effects of potash applications were small. This suggests that potash fertilization tends to offset the effects of seasonal factors which restrict the growth of the fruit. These factors are presumably of a climatic origin, but their nature is not known.

The effects of potash fertilization upon the size and other characteristics of the fruit of the 1941-1949 crops are shown in the accompanying table. The average increase in the percentage of fruit size 220 and larger was 6.9; the average decrease in the number of fruits per packing box was 11.6; while the average increase in the diameter of the fruit was 0.045 inch. The small increase in the average diameter had a considerable effect upon the packing house sizes.

Average Effects of Fertilization with Sulfate of Potash on Fruit Size, Expressed in Various Ways, and on other Characteristics of the Crop. Harvests of 1941-1949

Fertilizer treatment	Fruits size 220 and larger (per cent by volume)	No. of fruits per packing box	Fruit diameter (inches)	No. of fruits per tree	Yield (pounds)	Fancy and choice grades (per cent by volume)	
						Total of all sizes	Size 220 and larger
Potash	61.77	225.3	2.604	422.6	163.74	76.54	52.39
No potash	54.83	236.9	2.559	426.2	158.46	74.56	45.68
Difference	6.94	—11.6	0.045	—3.6	5.28	1.98	6.71

Fertilization with sulfate of potash did not affect the number of fruits harvested from the trees. Evidently there was no effect on fruit setting or preharvest drop. Since the use of potash fertilizer resulted in larger fruits, the weight of the crop was increased a little.

The commercial grade of the fruit was only slightly improved by potash fertilization. This improvement was associated with the larger size of the fruit. Large sizes were apparently graded more leniently. Although the over-all improvement in grade was small, it exerted a favorable effect upon the percentage of the fruit which is both larger in size and of better grade.

Additional evidence of the effect of potassium supply upon fruit size in the experimental orchard was obtained by determining the concentrations of this and other elements in the leaves. These were studied in relation

to the sizes of the fruit harvested in 1946-1949. A group of 30 fertilizer treatments was used for this study. A number of the treatments received applications of manure of other bulky organic materials. Others differed in respect to the use of cover-crops, phosphate or potash fertilizers, agricultural minerals, source and amount of nitrogen, etc.

Composite samples of spring-cycle leaves were harvested in December, 1948, for the analyses. Studies of the composition of the foliage in different months (to be published later) showed that samples taken at other seasons would have led to the same conclusions as those reported here.

It was found that the size of the fruits was highly correlated with the concentration of potassium in the dry weights of the leaves (see figure 2).

The relation of fruit size to potassium concentration was not at first clear. The sizes tended to be larger also when phosphorus was more abundant but smaller when nitrogen or calcium was high. However, the concentration of each element was found to be affected by the concentrations of the others. Special statistical procedures were necessary to show that the concentrations of potassium were the only ones which were firmly associated with the fruit sizes.

The increases in fruit size due to greater potassium absorption were limited. Maximum fruit sizes in the 1946-1949 crops occurred when the potassium content was about 1.3% in the dry weight of the December, 1948, leaf samples. In the crops of the individual years, maximum fruit size occurred at leaf concentrations which differed somewhat from this figure.

Large increases in the potassium content of the leaves resulted from the application of bulky organic materials. For example, a treatment which annually received 1.5 pounds of nitrogen per tree from dairy or feed-lot manure produced fruit of relatively large size. The leaves of the trees which received this fertilizer contained 1.22% of potassium. About 3 pounds of potash per tree were applied each year in the manure. Supplementing this treatment with applications of sulfate of potash fertilizer did not increase the size of the fruit, althougn the extra potash considerably increased the potassium in the leaves.

The potassium in the December leaf samples ranged from 0.75% to 1.59% of their dry weights. All of the values are greater than those which have been reported by several investigators to be sufficient to prevent yield reductions and visible deficiency symptoms.

It is recognized that other factors than potassium supply also influence fruit sizes. In these experiments, this is shown by the fluctuations from year to year in the size of the fruit from trees which have been consistently fertilized with the same materials. In any one year differences in fruit size also occurred when trees were fertilized with the same quantity of potassium. Inadequate availability of irrigation water is one factor which reduces the size of oranges, as shown by reports by members of the Agricultural Extension Service. Orchard management practices which affect the penetration of water into the soil may therefore affect fruit sizes.

The foregoing is reprinted from California Agriculture 3(4):5 published by the University of California College of Agriculture. The following text extends the original article.

E. R. Parker is Horticulturist in the Experiment Station, Riverside.

Winston W. Jones is Associate Horticulturist in the Experiment Station, Riverside.

The above progress report is based on Research Project No. 594.

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